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KEY

TO THE

AMERICAN

COMMON-SCHOOL ARITHMETIC

BY RUFUS PUTNAM,

PRINCIPAL OF THE BOWDITCH (ENGLISH HIGH) SCHOOL, SALEM, MASS.

BOSTON:
TAPPAN, WHITTEMORE & MASON,
114 WASHINGTON STREET.
1849.

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ADVERTISEMENT TO THE KEY.

THIS Key is not intended to give the pupil who may use it any assistance in solving the questions in the Arithmetic, except what is to be found in the answer alone. Those teachers who may wish their pupils to have the answers to the questions while preparing their lessons can have the Key bound in the same covers with the Arithmetic; and those who prefer that the pupil should not have the answers can have the Arithmetic without the Key; so that, in ordering the book, if the Arithmetic and Key are both wanted, it should be so stated, otherwise the Key will not be sent.

The author intends to publish, as soon as it can be prepared, an Appendix to the Key, for the use of teachers only; containing, 1st. Solutions, so far as may be desirable to assist the teacher in examining the work of his pupils. 2d. Such explanations and suggestions as the author may think proper to make in reference to the topics treated of in the Arithmetic. 3d. Additional questions, in most cases similar to those in the Arithmetic, to be dictated by the teacher to the pupil at each recitation, so as the more carefully to test his knowledge of the subject.

OMISSION.—ART. 143.

(11.) 5.515131; 1.791182; 22.459487.
(12.) 20.265,258; .028573; .032325.
(13.) .043,525; .816,496; 2.828,431.
(14.) 2.371,708. (15.) 2.695482; 2.172854.

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JANUARY 25, 1924

KEY.

Section I. — Numeration. [Art. 9 — 12.]

Art. **9.** (1.) Ten. (2.) One hundred. (3.) One thousand. (4.) Ten thousand. (5.) One hundred thousand. (6.) One hundred and one. (7.) One hundred and eighty. (8.) One thousand and one. (9.) One thousand and twelve. (10.) Two thousand and eighty-four. (11.) Seven thousand, eight hundred and four. (12.) Ten thousand and one. (13.) Thirty thousand, eight hundred and five. (14.) Thirty-eight thousand and fifty. (15.) Thirty thousand and eighty-five. (16.) Five hundred thousand and five. (17.) Three million, fifty thousand, six hundred and one. (18.) Eight hundred and fifty million, one hundred and sixty thousand, eight hundred and four.

II. (19.) 4 bil., 16 mil., 80 thous. and 900. (20.) 1 tril., 851 bil., 608 mil., 90 thous., 504. (21.) 50 tril., 80 bil., 90 mil., 607 thous. and 10.

10. (1.) 84. (2.) 904. (3.) 940. (4.) 1,001.
(5.)1,010. (6.) 1,101. (7.) 80,008. (8.) 80,080.
(9.) 80,088. (10.) 575,637. (11.) 8,000,035.
(12.) 34,034,034. (13.) 500,000,050. (14.) 6,000,006,600.
II. (15.) 15,000,000,000,040,008,040. (16.) 60,000,000,000,000,090,000,000,003,000. (17.) 15,000,000,000,008,000,000,000,400,008,000,000.

12. (1.) Five *tenths*. (2.) Five *hundredths*. (3.) Thirty-seven *thousandths*. (4.) One thousand and eight *ten thousandths*. (5.) Five hundred and one, — and 8 *hundredths*. (6.) Seven thousand one hundred and eight *ten thousandths*. (7.) Eight *thousandths*. (8.) 1,001 *millionths*. (9.) 16, — and 16 *hundredths*. (10.) 180, — and 18 *thousandths*. (11.) 7, — and 16 *hundred thousandths*. (12.) 30,175, — and 4 *hundredths*. (13.) 301,680, — and 45 *hun-*

dredths. (14.) 30.168, — and 45 *thousandths.* (15.) 3,016, — and 8,045 *ten thousandths.* (16.) 301, — and 68,045 *hundred thousandths.* (17.) 30, — and 168,045 *millionths.*

II. (18.) 3, — and 168,045 *ten millionths.* (19.) 30,168,-045 *hundred millionths.* (20.) 35, — and 100,041 *billionths.* (21.) 10,010,806, — and 3,000,010,806 *ten billionths.*

(22.) 581,006, — and 940,008,607 *hundred billionths.*

13. (1.) .04. (2.) .004. (3.) .0005. (4.) 00006. (5.) .000008. (6.) .14. (7.) .014. (8.) .104. (9.) .0075. (10.) .0851. (11.) .01845. (12.) .00016. (13.) .000058. (14.) .002506. (15.) 3.8. (16.) 41.07. (17.) 400.017. (18.) 4.0107. (19.) 84,016.0054. II. (20.) 5,000,040-.0000097. (21.) 50,040,075,054.05015. (22.) 5,000,090,-005,100.00016005. (23.) 84,016.0003024.

14. (13.) 4 tens; 45 units; 451 tenths; 4,516 hundredths. (14.) 1 hund.; 15 tens; 156 units; 1560 tenths; 15,604 hundredths. (15.) 30 hundredths; 300 thousandths.

II. (16.) 17 hundreds; 170 tens; 1,701 units; 17,010 tenths; 170,106 hundredths; 1,701,060 thousandths; 17,010,-600 ten thousandths; 170,106,000 hundred thousandths; 1,701,060,000 millionths. (17.) 8 ten thousands; 80 thousands; 804 hundreds; 8,041 tens; 80,416 units; 804,160 tenths; 8,041,605 hundredths; 80,416,058 thousandths; 804,-160,580 ten thousandths; 80,416,058,070 millionths; 804,160,-580,700 ten millionths. (19.) 80,570. (20.) 901,000. (21.) 7.5. (22.) 87.5. (23.) 90.45. (24.) .0001645. (25.) 105.617.

15. (1.) 8 dollars. (2.) 16 dollars. (3.) 25 dollars and 14 cents. (4.) 168 dol. 7 cts. (5.) 1,016 dol. 8 cts. (6.) 45 dol. 1 mill. (7.) 1000 dol. 1 ct. 1 mill. (8.) 8,049 dol. 10 cts. 8m. (9.) 10,010 dol. 10 cts. 1 mill. (10.) $20.00. (11.) $87.25. (12.) $1,007.09. (13.) $5.008. (14.) $15.037. (15.) $1000.018. (16.) $30,018.063.

SECTION II. — ADDITION.

18. (1.) 1,117 acres. (2.) 18,517 pounds. (3.) $8,110 dollars. (4.) 11,632,681 people. (5.) 12,251,973 cents. (6.) $1,132.531. (7.) $1683.45. (8.) $10,161.4475. (9.) 1,087.236. (10.) 5417.18449. (11.) 1,955,207; 2,234,822. (12.) 3,664,412; 4,604,345. (13.) 4,230,881;

5,166,032. (14.) 3,010,682; 5,058,154. (15.) 12,861,192; 17,063,353. (16.) 179 bushels. (17.) 1,330 pounds.
(18.) $360.18. (19.) $8550.09. (20.) $58,930.653.
(21.) 515849.07633. (22.) 61,970,910. (23.) 6,164,233-.0596. (24.) $479.569. (25.) 34.5 bushels; $26.10.
(26.) 1461 days; 2922 days; 3652.5 days; 5113.5 days; 7,305 days. (27.) 12 barrels; $66.805. (28.) $16,086.25.

SECTION III. — SUBTRACTION.

21. (1.) 222. (2.) 3,323. (3.) 2,362. (4.) 49,152. (5.) 210,002. (6.) 52,252. (7.) 5,214,000. (8.) 4,410,100. (9.) 490,782,849. (10.) 44,362,919. (11.) 558,992.
(12.) 979,798. (13.) 1,999.8999. (14.) 2912.181.
(15.) $283.35. (16.) $5,070.899. (17.) $3,554.915.
(18.) $3,878.898. (19.) 2,099,898.594983. (20.) $9.75; $1244.893; 3,468.6316. (21.) 156.997; 2,815.9796; 67,-191.9021. (22.) New England, 279,615; Middle, 939,933; Southern, 935,141; Western, 2,047,472. (23.) 206,352.
(24.) 160,198. (25.) 49,213,211. (26.) 3,699,924.98,186. (27.) $1.375. (28.) $8.375. (29.) $1124.55.

23. (1.) $2.46. (2.) The farmer must pay $0.125.
(3.) $5.125. (4.) $659.94. (5.) 179,682.4731. (6.) He owes in all $2,049.055; $340.64 more to A than B; $645.905 more to C than B; $305.265 more to C than A.
(7.) $950.945. (8.) 1,995,500. (9.) $288.75; $231.00; $173.25; 6 payments. (10.) $1,436.65. (11.) $6,887.00.
(12.) $2324.98.

SECTION IV. — MULTIPLICATION.

27. (1.) 246; 369; 492; 738; 984; 1,107. (2.) 7,035; 9,380; 11,725; 14,070; 16,415; 18,760. (3.) 113,578; 227,-156; 283,945; 397,523; 454,312; 511,101. (4.) 2,468; 4,215; 42,096; 27,419; 925,837; 609,610,860. (7.) 2,414.96; 241,085.406; $1016.33; $50.545. (8.) $39.375. (9.) $50-.80. (10.) $13.125. (11.) 153.5; 645.2. (12.) 5464.8; 4.54239. (13) .0,211,183. (14.) 3.150,054; .34,404,196; .0,058,807.

28. (1.) 1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97. (3.) 399; 2,329.2. (4.) 259.14; 135,756. (5.) 48,528; 771.936.
(6.) 40; 400; 4000. (7.) 4; 4; 4. (8.) 8,400; 791,600. (9.) 84,510,000; 310.4. (10.) 4,016.8; 31,600.8.

(11.) 308,090; $49,750. (14.) 1,447,200.
(15.) 267,175,300; 333,171,000; 2,250,000.
(17.) 350,160; 4,597,020.
(18.) 3,500; 300,000; 1,092,000. (20.) 41,344,000,000.
(21.) 2,512,000. (22.) 58,920,000,000.
(23.) 3,062,760,000,000.

29. (1.) 2,613,854,880. (2.) 742,126,203,000.
(3.) 33,183,000,000. (4.) 3,101,241,600.
(5.) 312,909,382,772. (6.) 1,631,165,900; 34,726,852.
(7.) 447,300,132.687; 406.4112.

31. (1.) $60.48. (2.) 405 trees.
(3.) 1215 barrels; $1,974.375. (4.) $1,767.825.
(5.) $763.00; 1050 cords. (6.) $1,496.25. (7.) $16.825.
(8.) 308s.; 517s. (9.) 186d.; 3,069d. (10.) 3,155qr.
(11.) 306d.; 1,530d.; 2,448d.; 7,650d.; 45,900d.
(12.) 2,922 da.; 3,652.5 da.; 5,565.75 da.; 13,664.25 da.
(13.) 168 h.; 2,856 h.; 9,625 h.
(14.) 1,800 min.; 15,480 min.; 24,751 min.
(15.) 2,118 sec.; 59,724 sec.; 32,882,584 sec.
(16.) 180 oz.; 3,600 dwt.; 86,400 gr.
(17.) 128 oz.; 2,560 dwt.; 61,440 gr. (18.) 60,087 gr.
(19.) $49.56. (20.) 756 qt.; 1512 pt.; 6,048 gi.
(21.) 1,068 qt.; 8,544 gi. (22.) 2,557 pt. (23.) $49.08.
(24.) $2.78. (25.) 246 pt.; 974 pt. (26.) $7.44.
(27.) 310 pt.; 579 pt. (28.) $2.30.
(29.) 320 rd.; 3,320 rd.; 4,895 rd.
(30.) 1,760 yd.; 4,218.5 yd.
(31.) 63,360 in.; 150,628 in. (32.) $396,875.
(33.) 190,080 lb.; 950,400 lb.; 4,752,000 lb.
(34.) $6,652.80; $33,264; $166,320; $399,168.
(35.) 4,000 sq. rd.; 1,680 sq. rd.; 1,128 sq. rd.
(36.) 1,073.75 sq. yd.; 9,663.75 sq. ft.
(37.) 38,548 sq. in. (38.) $10,890.
(39.) 695 oz.; 5,015 oz. (40.) $149.94. (41.) $9.67.
(42.) $0.875. (43.) Due to A, $59.995. (44.) $623.692.
(45.) $105. (46.) 105,700 cents; 1,057,000 mills.
(47.) 104,100 cents; 1,041,000 mills; 147,501 cents; 1,475,010 mills.
(48.) 501 cents; 5,010 mills; 300,000 cents 1 mill; 3,000,001 mills; 8,100,000 cents; 81,000,000 mills; 54,791 cents; 547,910 mills; 576,140 cents 8 mills; 5,761,408 mills.

(49.) 1,275,102.413,325; 862,192.475,625.
(50.) 264,716,837,536,171. (51.) 11.588,882,577.
II. (52.) 2,266,738,536,065.243.
(53). 6,090,359,364,278.68,048,432.
I. (54.) $18.71. (55.) $28.315. (56.) $65.95.
(57.) 487,972,800. (58.) 36,457,222.7175.
(59.) 78,233,819,664. (60.) 479,167,505,340,510.
(61.) 28,730,532.12,323,364..
(62.) 1,712,332,215.0,916,337,125.

SECTION V. — DIVISION.

37. (2.) 2,314 yds. (3.) 1,202 bu. (4.) 1,231 yds.
(5.) 12,341; 122,112; 6,221; 2,110,101; 41,201,201; 10,011; 4,213.
(6.) 1,051 lb. at 3 cts.; 788¼ lb. at 4 cts.; 630⅜ lb. at 5 cts.; 525⅝ lb. at 6 cts.; 450⅞ lb. at 7 cts.
(8.) 1,883; 21,433; 102,817⅞; 126,972⅝; 689,984⅜.
(9.) 10,269,170; 7,701,877¼; 6,161,502; 5,134,585; 4,401,072⅛; 3,850,938⅛; 3,423,056⅛; 3,080,751; 2,800,682 8/11; 2,567,292 6/12.
(10.) 4,273⅜; 1,112,223⅜.
(12.) 6,120 m. 7 fur.; 2,040 leagues, 7 fur.
(13.) 215,104 qr. 3 na.; 53,776 yd. 3 na.
(14.) 518 bu. 7 qt. 1 pt. (15.) 6,106 gal. 3 qt. 2 gi.
(16.) 732s. 2d. 1qr. (17.) 1,234⅞ bbl.

38. (2.) 1,257.04; 7,612.32.
(3.) 416.85; 680.002; 77.3,756. (4.) $45.271.
(5.) 8,935.112; 43,455.2,012; 696.7,936.
(7.) 921.535; 614.35; 460.7,675; 368.61; 307.178.
(8.) 729.54,957+; 638.355,875; 567.42,744+; 510.6,847.
(9.) 400,350.25,005; 133,450.08,335; 114,385.78,571; 88,966.72,223.
(10.) 250.5,403,505; 125.27,017,525; 83.5,134,501.
(11.) 776.16; .4,345. (12.) .161; 2,173.5; 28,000.
(13.) 517.42,833; 5,174.28,333; 51,742.83,333; 517,428.33,333; 5,174,283.33,333.
(14.) 102.1,734; 1,021.734; 10,217.34; 102,173.4.
(15.) 12,452.14,297; 1,089,562.51; 9,685,000.0888.

39. (1.) 3,046.17; 304.617. (2.) 30.4,617; 3.04,617.
(3.) 3.04,671; .304,671; .0,304,671.

(4.) .00,851,865; .000,851,865.
(5.) 815.64; 81.564; 8.1,564.
(7.) 172.539; 12.940,425; .862,695. (8.) .0001,742,934.
(9.) 10,215.12; 729.65,142,857; 6.38,445; 5.6,750,666+.
(10.) 1.0048,566+; .03,349,522; .000,602,914.
(12.) $520\frac{841}{8000}$; $69\frac{2841}{60000}$; $5,201\frac{41}{800}$.
(14.) 13,070 min. 6 sec.; 217 h. 50 min. 6 sec.
(17.) $1172\frac{143}{300}$; $87\frac{3743}{4000}$; $5862\frac{23}{80}$.
(18.) $3466\frac{875}{1200}$; $46\frac{2}{3}\frac{9}{0}\frac{0}{0}\frac{7}{0}\frac{5}{0}$; $4160\frac{75}{1000}$.
(19.) 1160.33; 5801.65; 580.165.
(20.) 48.801,142,857; 4.2,701; 569.34,666.
(21.) .31,045; 1.03,483+; .003,449+.
(22.) 6.8,395; 4.559,666+.

40. (1.) $23,580,008\frac{2}{15}$; $21,895,721\frac{13}{14}$.
(2.) $20,436,007\frac{1}{15}$; $19,158,756\frac{19}{18}$.
(3.) $18,031,770\frac{6}{17}$; $17,030,005\frac{16}{18}$; $16,133,689\frac{15}{19}$.
(4.) $18,168,263\frac{11}{23}$; $10,996,580\frac{29}{68}$; $4,916,118\frac{29}{65}$.
(5.) $3,979,714\frac{20}{105}$; $1,204,236\frac{169}{171}$.
(7.) $22\frac{29}{17}\frac{0}{5}\frac{8}{0}\frac{3}{0}$; $149\frac{4}{7}\frac{2}{1}\frac{6}{8}\frac{3}{0}$. (8.) $11\frac{35}{84}\frac{7}{3}\frac{8}{0}\frac{3}{0}$; $1\frac{2}{8}\frac{0}{7}\frac{3}{1}\frac{0}{0}\frac{8}{0}\frac{8}{0}$.
(9.) $27. (10.) $584\frac{12}{8}$. (11.) 15,952 miles 38 rods.
(12.) $18\frac{19}{24}$ miles. (13.) $6.15\frac{28}{350}$. (16.) 2.67,919,606.
(17.) 2,142.85,714,285; 1.8,382,352.
(18.) 1,442.307,692; 2.1,428,571; .0166,666+.
(19.) .00,000,018+; .0,000,073—.
(20.) .000,000,012+; .00,00016+; .00,000,005.
(21.) $5.348—. (22.) $2.308+.

42. (1.) $97\frac{2}{6}\frac{9}{7}\frac{4}{5}$. (2.) 24 T. (3.) $28.72—.
(4.) 20.9 cords. (5.) $6.03\frac{51}{359}$.
(6.) 460,495d. 3qr.; 38,374s. 7d.; £1,918 14s.
(7.) 18,045 cts. 1 mill; $180.451.
(8.) 351,704 cts. 7 mills; $3,517.047.
(11.) 8 yr. 175 da. 8 h. 15 min.
(12.) 159 ℔. 0 ʒ. 2 ʒ. 2 ℈.
(13.) 14 T. 4 cwt. 2 qr. 27 lb.
(14.) 36 m. 1 fur. 3 rd. 3.5 yd.
(15.) 166 m. 1 rd. 4.5 yd.
(16.) 18,917 yd. 3 qr. 2 na. 1.5 in. (17.) 5 A.
(18.) 1 sq. m. 355 A. 1 R. 22 sq. rd. 14.5 sq. yd.
(19.) 17 cu. yd. 10 cu. ft. 218 cu. in.
(20.) 102 bu. 6 qt. 1 pt. (21.) 8,518 gal. 1 pt.
(22.) 47 da. 13 h. 6. min. 40 sec.

(23.) $374\frac{23}{231}$ w. gal.; $321\frac{1823}{2688}$ half pk.
(24.) 279.133,333+. (25.) .3,333+; .6.
(26.) .75; .5,333+. (27.) .555+; 57.125.
(28.) 5.762,195; 14.808,023—; 3.61,111+.
(29.) $113\frac{4}{14}$. (30.) $93\frac{50}{107}$; $139\frac{75}{847}$.
(31.) $102\frac{289021}{800016}$; $290\frac{3062888}{3142008}$. (32.) $50\frac{8881}{100701}$; $35\frac{182}{851}$.
(33.) 10,801. (34.) $0.625. (35.) 24.5 bu. (36.) 25 bu.
(37.) 25. (38.) $10\frac{10}{24}$ miles. (39.) $9\frac{84}{324}$ miles.
(40.) 250 h. = 10 da. 10 h. (41.) $355\frac{3}{25}$.
(42.) 208 times. (43.) 2,874.3,631; 1,057,394,000.
(44.) 15 degrees.

43. (1.) 14,239,646 dr. (2.) 8 T. 9 cwt. 2 qr. 21 lb. 7 oz.
(3.) 14,854,575 gr. (4.) 660 lb. 6 dwt. 21 gr.
(5.) 2,119.25 in. (6.) 19,208 E. E. 1 qr. 1 na.
(7.) 2,415,757 qr. (8.) £85,257 9d. 2qr.
(9.) 4,360,426 pt. (10.) 146,553 gi.
(11.) 25,549,013 gal. 3 gi. (12.) 82,669 sq. rods.
(13.) 140,440.75 sq. feet. (14.) 5469 A. 3 R. 4 sq. rd.
(15.) 735,484 cu. in. (16.) 396 cu. yd. 413 cu. in.
(17.) 14,543,409 cu. in.; $62,958\frac{111}{231}$ w. gal.; $51,572\frac{105}{282}$ beer gal.; $54,104\frac{2538}{2688}$ dry gal. (18.) 51,420 lb.
(19.) 51,540 lb.; 25,770 lb.; 48,104 lb.; 48,104 lb.
(20.) 175,200 lb.; 169,800 lb.
(21.) 40 bbl. and 176 lb. over.
(22.) 50 bu. 18 lb.; 53 bu. 50 lb.; 100 bu. 18 lb.
(23.) 171,500 lb. (24.) 4294 bbl. 51 lb.

45. (1.) 51,044,305.2. (2.) $20.88; 116 lb.
(3.) $421\frac{21}{24}$ gal. (4.) $75.41. (5.) $4.75.
(6.) $86.425. (7.) $181.94; $0.182. (8.) $6.25.
(9.) $337.50; $112.50. (10.) $445.15; $100.88.
(11.) $47.4825; $230.1075. (12.) 15 yd.
(13.) 1000 lb.; 5 bbl.
(14.) 837 dwt.; 64 spoons, and 5 dwt. over.
(15.) 23 coats, and 2 yd. over. (16.) 55 bu.
(17.) 3 cts.; 15 cts.; 48 cts.; 75 cts.; $1.065.
(18.) $0.84. (19.) $163.125. (20.) $10.71. (21.) 2 T.
(22.) $2000.50; $5.13—. (23.) $2100.50; $5.386—.
(24.) $103.14. (25.) $5.536—. (26.) $0.015.
(27.) 9 cts. 12 rem. (28.) 15 yd. (29.) $724.50.
(30.) $11\frac{170}{625}$. (31.) $2.40; $4.80; $8.40.
(32.) $27.75. (33.) $21.00.

(34) 13 pk.; 78 pk.; 247 pk. = 61 bu. 3 pk.
(35.) $0.055; $9.735. (36.) 983,791qr.
(37.) £124 17s. 9d. (38.) 173 lb. 7 oz. 6 dwt. 16 gr.
(39.) 2,793,599 gr. (40.) 14,239,646 dr.
(41.) 2530 lb. 13 oz. 7 dr. (42.) 15221 yd. 1 ft.
(43.) 373,236 sq. in. (44.) 9525 sq. yd. 8 sq. ft. 126 sq. in.
(45.) 46,656 cu. in. (46.) 938 cu. yd. 1 cu. ft. 891 cu. in.
(47.) 31,556,937 sec. (48.) 184 da. (49.) 91 da.
(50.) 91 da. (51.) 162 tons.

46. (1.) $153.75. (2.) $33.875. (3.) $27.85.
(4.) $99.58. (5.) $14.30. (6.) $72.68. (7.) $8.85.
(8.) $56.91½. (9.) $14.05.

(10.) *Boston, Feb.* 15, 1849.

CHARLES TAPPAN,

Bought of CHARLES STODDARD,

A black horse, warranted sound and kind, and only five years old, ... $150.

(11.) $134.50. (12.) $61.00.

47. (11.) 21 days. (12.) 31¼ da.; 20⅝ da.; 10$\frac{5}{37}$ da. (13) 170 m.; 150 m.; 510 m.
(14.) 4\frac{4}{5}$ = $4.114⅔; 10\frac{3}{5}$ = $10.971⅓; 37\frac{1}{5}$ = $37.028⅓. (15.) $112.50. (16.) 52.00. (17.) $6; $39. (18.) $7.50. (19.) $8. (20.) 6 times. (21.) 7½ times.
(22.) 8 times. (23.) $0.48; $12.36.
(24.) 48 times; 42 times. (25.) 24 cents.
(26.) 48 times; 27 times. (27.) $1.30; $11.05.
(28.) $3.87. (29.) 17 cows.

SECTION VI.

64. (1.) £40 5s. 9d. 3qr. (2.) 18 T. 13 cwt. 3 qr. 6 lb.
(3.) 43 lb. 3 oz. 4 dwt. 12 gr.
(4.) 41 m. 7 fur. 17 rd. 1½ yd. 2 ft. 8 in. = 41 m. 17 rd. 2 yd. 1 ft. 2 in. (5.) 34 yd. 3 qr. 2 na.
(6.) 4 sq. m. 9 A. 1 R. 27 rd. 15.75 yd. 0 ft. 110 in. = 4 sq. m. 9 A. 1 R. 27 sq. rd. 15 sq. yd. 7 sq. ft. 74 sq. in.
(7.) 124 C. 5 C. ft. (8.) 141 cu. yd. 11 cu. ft. 942 cu. in.
(9.) 85 bu. 3 pk. 3 qt. (10.) 1602 gal. 1 qt. 1 pt. 1 gi.
(11.) 46 yr. 316.5 d. 1 h. 59 min. 55 sec. = 46 yr. 316 da. 13 h. 59 min. 55 sec. (12.) 515° 36′ 16″.

65. (2.) £7 2s. 11d. 1qr.
(3.) 6 T. 14 cwt. 3 qr. 24 lb. 13 oz. 9 dr.
(4.) 9 m. 5 fur. 36 rd. 0 yd. 1 ft. 3 in.
(5.) 432 gal. 3 qt. 1 pt. 1 gi. (6.) 6 bu. 3 pk. 6 qt. 1 pt.
(7.) 1 fur. 39 rd. 5 yd. 2 ft.
(8.) 1 A. 2 R. 23 sq. rd. 29.5 yd. 4 ft. 16 in. = 1 A. 2 R. 23 sq. rd. 29 sq. yd. 8 sq. ft. 88 sq. in.
(9.) 13 da. 17 h. 52 min. 44 sec. (10.) 7 yr. 9 mo. 8 da.
(11.) 381 ch. 30 bu. 2 pk. 5 qt. 1 pt. (12.) 7 S. 28° 19′ 37″.

66. (2.) 255 bu. 1 pk.; 33 bu. 3 pk. 2 qt. 1 pt.
(3.) 626 gal. 2 qt. 0 pt. 1 gi.; 1879 gal. 2 qt. 0 pt. 3 gi.; 3,759 gal. 0 qt. 1 pt. 2 gi.
(4.) 226 lb. 11 oz. 14 dwt. 20 gr.; 907 lb. 10 oz. 19 dwt. 8 gr.; 1361 lb. 10 oz. 9 dwt.
(5.) 7 yr. 160 da. 18 h. 58 min. 15 sec.; 37 yr. 73 da. 22 h. 51 min. 15 sec.; 52 yr. 30 da. 12 h. 47 min. 45 sec.
(6.) 367 m. 5 fur. 36 rd. 2 yd.; 551 m. 4 fur. 34 rd. 3 yd.; 735 m. 3 fur. 32 rd. 4 yd.

67. (3.) £3 7s. 5d. $1\frac{4}{5}$qr.; £2 8s. 2d. $0\frac{1}{7}$qr.; £1 5s. 11d. $1\frac{4}{13}$qr.
(4.) 368 gal. 2 qt. 1 pt. 1 gi.; 69 gal. 0 qt. 0 pt. $3\frac{1}{8}$ gi.
(5.) 3 m. 7 fur. 8 rd. 3 yd. 2 ft. 11 in.; 1 m. 7 fur. 24 rd. 1 yd. 2 ft. $11\frac{1}{2}$ in.; 3 fur. 36 rd. 0 yd. 1 ft. $5\frac{7}{8}$ in.
(6.) 3 yd. 1 qr. $2\frac{12}{35}$ na.
(7.) 27 A. 1 R. 18 sq. rd. 5 sq. yd. 5 sq. ft. 76 sq. in.; 13 A. 2 R. 29 sq. rd. 2 sq. yd. 7 sq. ft. 38 sq. in.
(8.) 15 lb. 8 oz. 19 dwt. $11\frac{2}{3}$ gr.; 17 lb. 11 oz. 19 dwt. $9\frac{3}{7}$ gr.; 8 lb. 4 oz. 15 dwt. $17\frac{3}{15}$ gr.

68. (1.) £1 5s. $6\frac{3}{4}$d.; £6 7s. 9d. 3qr.
(2.) 30 cwt. 1 qr. 21 lb. (3.) 3,409 lb.; $221.585.
(4.) 11 cwt. 1 qr. 25 lb. (5.) 683 bu. 2 pk.; 2734 pk.
(6.) 265 lb.; $46.37\frac{1}{2}$. (7.) 26 lb. 8 oz. (8.) $6.62\frac{1}{2}$.
(9.) £28 6s. 3d.; £2 0s. 4d. $2\frac{1}{15}$qr.
(10.) 15 m. 5 fur. 19 rd. 0 yd. $2\frac{4}{5}$ ft.
(11.) 47 m. 5 fur. 13 rd. 1 yd. $2\frac{3}{5}$ ft. (12.) 93 bu. $1\frac{5}{8}$ pk.
(13.) 22 T. 10 cwt. 3 qr. 14 lb.
(14.) 1 T. 10 cwt. 0 qr. $6\frac{8}{15}$ lb. (15.) 569 lb. 4 oz.
(16.) 141 gal. $1\frac{3}{8}$ qt. (17.) 17 A. 2 R. 11 sq. rd.
(18.) 22 lb. 8 oz. 5 dwt. (19.) 1 lb. 6 oz. 3 dwt.; $22.6875.
(20.) 468 sq. rd.; 127,413 sq. ft.; $1274.13.

(21.) 1 A. 2 R. 32 rd. $23\frac{1}{4}$ yd. 1 ft. = 1 A. 2 R. 32 sq. rd. 23 sq. yd. 3 sq. ft. 36 sq. in.
(22.) 1 C. $35\frac{61}{67}$ cu. ft. (23.) 24 yd. 2 qr. 2 na.
(24.) 1 yd. 2 qr. $2\frac{4}{15}$ na.
(25.) 5 bu. 3 pk. 4 qt.; 1 pk. $1\frac{8}{20}$ qt. (26.) 2 C. $1\frac{19}{21}$ C. ft.

69. (4.) 2 yr. 4 mo. 28 da.; 7 yr. 6 mo. 25 da.; 15 yr. 4 mo. 29 da.; 13 yr. 6 mo. 9 da.; 6 mo. 28 da.
(5.) 2 yr. 5 mo. 29 da.

70. (1.) 2 sq. in.; 3 sq. in.; 5 sq. in.
(2.) 10 sq. in.; 15 sq. in. (3.) 20 sq. ft.; 40 sq. ft.
(4.) 3888 sq. in. = 27 sq. ft. (5.) 243 sq. ft.; 9 boards.
(6.) 3008 sq. in. = 20 sq. ft. and 128 sq. in. over.
(7.) 360 sq. ft.; 720 sq. ft.
(8.) 240 sq. ft.; 480 sq. ft.; 600 sq. ft.; 600 sq. ft.
(9.) 1800 sq. ft. = 200 sq. yd.; $12.00. (10.) $36.00.
(11.) 1920 sq. in.; 23,040 sq. in.; 160 sq. ft.; $12.80.
(12.) 74 sq. yd. (13.) 1,920 sq. rd.; 12 acres.
(14.) 8 acres. (15.) $31,240.6875.
(16.) 32 pieces; 32 cu. in. (17.) 64 cu. in.; 96 cu. in.
(18.) 9 cu. ft. (19.) 1 C.
(20.) 1200 cu. ft. = 75 C. ft. = 9 C. and 3 C. ft. over.
(21.) 37.5 C.; $168.75.
(22.) 225,621 cu. in. = 130 cu. ft. and 981 cu. in. = 130.5677 cu. ft. (23.) 10.88 tons.
(24.) 1,275 gal.

SECTION VII.

71. (8.) $35 = 7 \times 5$; $48 = 2^4 \times 3$; $60 = 2^2 \times 3 \times 5$; $72 = 2^3 \times 3^2$; $275 = 5^2 \times 11$; $864 = 3^3 \times 2^5$; $1084 = 2^2 \times 271$; $35{,}952 = 2^4 \times 3 \times 7 \times 107$.

72. (2.) 2; 3. (3.) 1; 1; 2. (4.) 14; 12. (5.) 8; 18. (6.) 8; 18. (7.) 7.

73. (3.) 12; 60; 24; 20; 24; 60.
(6.) 120; 60; 900; 525.
(7.) 144; 60; 2520; 2520.

74. (2.) $127\frac{1}{2}$. (3.) $33\frac{1}{3}$; 27. (7.) 4. (8.) $5\frac{1}{15}$.
(9.) 50; 100; 75; 60; 40; $18\frac{3}{4}$; $9\frac{3}{13}$; 6; 4.
(10.) 168 times 12; 112 times 18; 72 times 28; 63 times

32; 56 times 36; 48 times 42; 36 times 56; 84 times 24; 42 times 48; 24 times 84; 21 times 96; 7 times 288.

(11.) $1\frac{1}{5}$. (12.) $157\frac{1}{2}$.

SECTION VIII.

77. (2.) $\frac{27}{44}$; $\frac{3}{5}$; $\frac{11}{12}$. (3.) $\frac{3}{14}$; $\frac{1727}{14710}$. (4.) $\frac{41}{244}$; $\frac{41}{152}$.

78. (2.) $4\frac{7}{13}$; $37\frac{1}{9}$. (3.) $92\frac{3}{5}$; $49\frac{13}{17}$. (4.) $5\frac{7}{16}$; $3\frac{19}{27}$.
(5.) 10; $248\frac{8}{121}$. (6.) $244\frac{16}{17}$; $518\frac{103}{1548}$.
(7.) .75; .4; .125. (8.) .875; .9; .333+.
(9.) .666+; .6; .5,714,285+.
(10.) .555+; .5454+; .64,814.
(11.) .0222+; .0038,684; .002,997+.
(12.) 1.8; 2.142,857; 1.095,238.
(13.) 3.266+; 144.68; 143.25714.
(14.) 4 fourths; 12; 13; 29; 33.
(15.) 7 sevenths; 21; 23; 60; 40; 90.
(16.) 8 eighths; 24; 25; 33; 43; 101; 167.
(17.) $\frac{7}{2}$; $\frac{15}{4}$; $\frac{21}{8}$; $\frac{67}{8}$; $\frac{42}{5}$; $\frac{95}{9}$; $\frac{192}{7}$; $\frac{128}{5}$; $\frac{216}{8}$; $\frac{255}{8}$; $\frac{143}{8}$.
(18.) $\frac{6084}{11}$; $\frac{2732}{15}$. (19.) $\frac{43058}{43}$; $\frac{12072662}{401}$.
(20.) $\frac{3}{10}$; $\frac{1}{250}$; $\frac{207}{500}$. (21.) $\frac{1081}{1000000}$; $\frac{1}{20}$; $\frac{217}{2000}$.
(22.) $\frac{7}{2}$; $\frac{161}{25}$; $\frac{4023}{50}$. (23.) $\frac{14007}{1000}$; $\frac{7.008.001}{10,000}$; $\frac{30.001.081}{10,000,000}$.
(24.) $\frac{3}{1}$; $\frac{8}{1}$; $\frac{15}{1}$; $\frac{145}{1}$.

80. (19.) $99\frac{17}{25}$; $62\frac{5}{28}$; $33\frac{17}{105}$.
(20.) $10615\frac{23}{27}$; $7961\frac{8}{9}$; $6369\frac{23}{45}$; $4549\frac{4}{63}$.
(21.) $192\frac{1}{8}$; $96\frac{1}{16}$; $64\frac{1}{24}$. (22.) $48\frac{1}{32}$; $36\frac{3}{128}$; $23\frac{11}{200}$.

81. (1.) $1\frac{17}{30}$; $7\frac{5}{6}$; $23\frac{1}{2}$. (2.) $5\frac{13}{80}$; $83\frac{1}{4}$; $104\frac{3}{4}$; $209\frac{1}{2}$
(3.) $2272\frac{3}{4}$; $3030\frac{1}{3}$; 9091; $4545\frac{1}{2}$.
(4.) $1\frac{17}{20}$; $3\frac{15}{32}$; $6\frac{39}{160}$; $18\frac{1}{2}$.
(5.) $5541\frac{16}{19}$; $27,709\frac{4}{19}$; $35,098\frac{1}{3}$; $55,418\frac{8}{19}$.
(6.) $2\frac{2}{7}$; $\frac{4}{7}$; $\frac{3}{7}$; $\frac{1}{7}$. (7.) $\frac{27}{317}$; $\frac{18}{317}$; $\frac{9}{317}$; $\frac{2216}{212339}$.
(8.) $\frac{1335}{14411}$; $\frac{27}{14411}$; $\frac{9}{14411}$; $\frac{3}{14411}$. (9.) $6\frac{3}{11}$; $2\frac{1}{11}$; $5\frac{1}{35}$.
(10.) $2105\frac{47}{210}$; $853\frac{243}{518}$; $4\frac{468897}{3538800}$.
(11.) $402\frac{192213}{550500}$; $16\frac{2469013}{14380700}$.

82. (1.) $\frac{1}{120}$; $\frac{1}{30}$; $\frac{1}{15}$. (2.) $\frac{1332}{14}$; $\frac{978}{49}$.
(3.) $\frac{180}{7}$; $\frac{1065}{112}$. (4.) $\frac{1}{1}$; $\frac{13}{100}$; $\frac{7146}{100000}$.

83. (1.) $.\dot{6}$; $3.\dot{6}$; $.\dot{3}\dot{6}$; $.0\dot{1}\dot{5}$; $8.7\dot{1}4285\dot{7}$.
(2.) $\frac{4}{9}$; $\frac{45}{99} = \frac{5}{11}$; $\frac{46}{111}$; $5\frac{16}{37}$.
II. (3.) $\frac{41}{990}$; $\frac{123323}{333000}$; $\frac{7}{990}$; $\frac{5}{9900} = \frac{1}{1980}$;
(4.) $\frac{7}{22}$; $5\frac{2501217}{5555550}$; $30\frac{37727}{99990}$; $2\frac{1703}{333300}$; $\frac{4004888}{9999000}$.

84. (7.) $\frac{6}{8}$; $\frac{9}{12}$; $\frac{12}{16}$; $\frac{15}{20}$; $\frac{18}{24}$; $\frac{21}{28}$.
(8.) $\frac{10}{12}$; $\frac{15}{18}$; $\frac{20}{24}$; $\frac{24}{30}$; $\frac{25}{42}$; $\frac{45}{54}$.
(10.) $3\frac{1}{2}$ 8ths $= \frac{3\frac{1}{2}}{8}$ pk.
(11.) $9\frac{3}{5}$ 16ths $= \frac{9\frac{3}{5}}{16}$ lb.; 12 20ths $= \frac{12}{20}$ oz.
(12.) $13\frac{1}{3}$ 24ths $= \frac{13\frac{1}{3}}{24}$ da.; $22\frac{1}{2}$ 60ths $= \frac{22\frac{1}{2}}{60}$ h. $42\frac{6}{7}$ 60ths; $= \frac{42\frac{6}{7}}{60}$ min.

85. (5.) $\frac{9}{24}, \frac{10}{24}$; $\frac{16}{20}, \frac{15}{20}$; $\frac{15}{24}, \frac{16}{24}$; $\frac{7}{12}, \frac{9}{12}$; $\frac{30}{72}, \frac{31}{72}, \frac{10}{24}$; $\frac{42}{70}, \frac{60}{70}, \frac{49}{70}$; $\frac{16}{40}, \frac{15}{40}, \frac{28}{40}$.
(6.) $\frac{15}{40}, \frac{25}{40}$; $\frac{28}{60}, \frac{27}{60}$. (7.) $\frac{135}{360}, \frac{200}{360}, \frac{96}{360}$; $\frac{27}{72}, \frac{32}{72}, \frac{39}{72}$.
(8.) $\frac{63}{72}, \frac{42}{72}, \frac{28}{72}, \frac{21}{72}$; $\frac{96}{360}, \frac{75}{360}, \frac{80}{360}$.
(9.) $\frac{408}{2040}, \frac{490}{2040}, \frac{425}{2040}, \frac{612}{2040}$; $\frac{1760}{3960}, \frac{960}{3960}, \frac{616}{3960}, \frac{1485}{3960}$.
(10.) $\frac{2078}{11088}, \frac{3080}{11088}, \frac{7560}{11088}, \frac{4224}{11088}$; $\frac{300}{700}, \frac{175}{700}, \frac{630}{700}, \frac{343}{700}$.

86. (8.) 960qr.; 1176qr.
(9.) $£\frac{1}{960}$; $£\frac{7}{960}$; $£\frac{9}{320}$; $£\frac{151}{192}$.
(10.) $\frac{1}{5760}$ lb.; $\frac{17}{5760}$ lb.; $\frac{1163}{2880}$ lb.
(11.) $\frac{31}{32}$ gal. (12.) £.02812$\frac{5}{6}$; £.7864583+.
(13.) .0001736 lb.; .00295 lb.; .4038194 lb.
(14.) .96875 gal. (15.) .109375 m. (16.) .107954 m.
(17.) .05022 m. (18.) .18452 wk. (20.) .348709— A.
(21.) .1252 yr. (22.) $\frac{7}{9582}\frac{3}{0}$. (23.) $\frac{1}{1428}$; $\frac{41}{2388}$.
(24.) $\frac{823}{5578}$. (25.) $\frac{60}{121}$; $\frac{82}{121}$; $\frac{201}{1210}$; $\frac{6}{605}$; $\frac{24}{1210}$.
(26.) $\frac{83}{740}$; $\frac{1683}{74000}$; $\frac{1}{7400}$; $\frac{27}{9250}$.

87. (7.) $\frac{4}{5}$ pt.; $\frac{10}{9}$ pt.; $\frac{128}{29}$ pt. (8.) .05 gal.
(9.) $\frac{140}{27}$ lb.; $\frac{84}{85}$ lb. (11.) $\frac{1}{12960}$; $\frac{1}{1280}$; $\frac{5}{96}$ lb.
(12.) $\frac{1}{704}$ m. (13.) $\frac{1}{2100}$ A.
(14.) .34 $= \frac{17}{50}$ na.; 2.72 na. $= \frac{68}{25}$ na.
(15.) 2.88 $= \frac{72}{25}$ in.; 1.3008 $= \frac{813}{625}$ in.
(16.) $\frac{1}{19800}$ m.; $\frac{1}{99000}$ m. (17.) $\frac{1}{3872}$ A.; $\frac{1}{76230}$ A.
(18.) $\frac{20}{13148}$ yr.; $\frac{1}{7012}\frac{1}{8}$ yr.
(19.) 157.788 m. $= \frac{3}{2}\frac{9}{5}\frac{4}{0}\frac{4}{0}\frac{7}{0}$ m.; 403.2 m. $= \frac{2016}{5}$ m.
(20.) $\frac{7}{35200}$ m. = .00019886 m.; $\frac{53}{2640000}$ m. = .000020-075 m. (21.) 38.616 in. $= \frac{4}{125}\frac{82}{0}$ in.; 69.3 in. $= \frac{693}{10}$ in.
(22.) $\frac{1584}{125}$; $\frac{231}{10}$. (23.) $\frac{7}{17600}$; $\frac{53}{1320000}$.
(24.) $\frac{1}{13148}$; $\frac{7}{2805}\frac{1}{12}$. (25.) $\frac{1}{13552}$; $\frac{1}{2668805}$.
(26.) $\frac{13148}{12150}$; $\frac{672}{25}$. (27.) $\frac{1}{742150}$; $\frac{1}{2712150}$.

88. (3.) 11s. 1d. $1\frac{1}{3}$qr.; $5\frac{1}{7}$d.; 1.2qr.
(4.) 8 oz. 0 dwt. 19.2 gr.; 11 dwt. $2\frac{2}{3}$ gr.
(5.) $4\frac{1}{3}$. $4\frac{1}{3}$.; $1\frac{1}{3}$. 0 ℈. 7.2 gr.
(6.) 8 cwt. 2 qr. 8 lb.; $21\frac{1}{4}$ lb.; 24 lb. 8 oz.; 2 oz. $8\frac{8}{15}$ dr.
(7.) 1 qt. 1 pt.; 1 qt. 1 pt. 3.456 gi.; $1\frac{1}{8}$ pt.
(8.) 16 rd. 3 yd. 2 ft.; 1 yd. 2 ft. 9.3 in.; 2 ft. 7.356 in.; $5\frac{1}{7}$ in. (9.) \$.375; \$.75; \$.625; \$.44$\dot{4}$; \$.706—.
(10.) \$.66$\dot{6}$; \$.682—; \$4.55$\dot{5}$; \$17.385—; \$20.158—.
(11.) 2s. 10d. 3.776qr.; 6d. 3.4368qr.; 1 sq. ft. 95.3712 sq. in. (12.) 2 pk. 4 qt. 1 pt. $2\frac{2}{3}\frac{2}{3}$ gi.; $3\frac{1}{8}$ qt.
(13.) 3 fur. 17 rd. 2 ft. $4\frac{2}{7}$ in.
(14.) 2 R. 22 sq. rd. 25 sq. yd. 8 sq. ft. $51\frac{3}{7}$ sq. in.; 12 sq. rd.; 18 sq. yd. 1 sq. ft. $50\frac{2}{5}$ sq. in.
(15.) $\frac{2}{11}$ sq. m. = 174 A. 2 R. 7 sq. rd. 8 sq. yd. 2 sq. ft. 36 sq. in.; .5816 A. = 2 R. 13 sq. rd. 1 sq. yd. 6 sq. ft. 35.424 sq. in.; $\frac{3}{8}$ yr. = 136 da. 23 h. 15 min.; .1084 m. = 34 rd. 3 yd. 2 ft. 4.224 in.; .30716 C. = 2 C. ft. 7.31648 cu. ft.; .1516 cu. yd. = 4 cu. ft. 161.0496 cu. in.; $\frac{8}{15}$ deg. = 32 min.; $\frac{7}{16}$ C. = $3\frac{1}{2}$ C. ft.

89. (12.) $5\frac{2}{7}\frac{5}{2}$. (13.) $7\frac{1}{2}\frac{1}{4}$. (14.) $26\frac{77}{3}\frac{7}{6}$. (15.) $85\frac{5}{3}\frac{5}{2}$.
(16.) $208\frac{1}{9}\frac{2}{7}\frac{3}{5}$. (18.) 3 yr. 10 h. 44 min. $14\frac{1}{8}\frac{3}{4}$ sec.
(19.) 2 pk. 0 qt. $1\frac{1}{5}$ pt. (20.) 19 gal. 1 qt. 1 pt. 2.224 gi.
(21.) 2 qr. $0\frac{7}{3}\frac{7}{6}$ na. (22.) 2 qr. 0 lb. 6 oz. $2\frac{2}{1}\frac{3}{5}$ dr.
(23.) 3 fur. 17 rd. 5 yd. 1 ft. $1\frac{3}{3}\frac{3}{5}$ in.
(24.) 1 A. 3 R. 18 sq. rd. 1 sq. yd. 2 sq. ft. 120.384 sq. in.

90. (9.) $\frac{1}{6}\frac{1}{0}\frac{2}{0}$; $3\frac{2}{2}\frac{6}{8}\frac{6}{5}$. (10.) $2\frac{1}{1}\frac{7}{7}\frac{2}{5}$; $181\frac{1}{8}\frac{4}{8}\frac{8}{8}$. (11.) $\frac{1}{1}\frac{8}{0}\frac{8}{5}$.
(12.) $10\frac{1}{1}\frac{0}{0}\frac{8}{6}\frac{1}{4}$. (13.) 5s. 0d. $1\frac{1}{1}\frac{9}{7}$qr.
(14.) 3s. 4d. 2.68qr.; 1 qr. 0 lb. 6 oz. 14.08 dr.
(15.) $74\frac{3}{4}\frac{2}{1}$; $81\frac{8}{7}\frac{4}{5}$; $25\frac{4}{1}\frac{5}{3}$.
(16.) 5 fur. 28 rd. 2 yd. 1 ft. $3\frac{3}{7}$ in.
(17.) 2 da. 13 h. 5 m. $5\frac{5}{1}\frac{1}{1}$ sec.

91. (3.) $\frac{5}{5}\frac{1}{6}$; $\frac{1}{6}$. (4.) $\frac{2}{4}\frac{0}{5}$; $\frac{1}{5}\frac{7}{6}\frac{2}{2} = 34\frac{2}{5}$.
(5.) $\frac{1}{1}\frac{5}{1} = 1\frac{4}{1}\frac{4}{1}$; $\frac{5}{8}\frac{1}{1} = 6\frac{3}{8}$.
(6.) $\frac{1}{2}\frac{1}{5}\frac{0}{0}\frac{4}{4} = 44\frac{4}{2}\frac{4}{5}$; $\frac{1}{2}\frac{0}{7}\frac{4}{2}\frac{2}{2}\frac{4}{7} = 383\frac{7}{2}\frac{1}{7}\frac{1}{2}$; $361\frac{5}{1}\frac{1}{6}$.
(7.) $\$\frac{1}{6}\frac{2}{4} = \$0.765\frac{5}{8}$. (8.) $\frac{2}{6}\frac{5}{4}\frac{6}{7}$ ct. = $\$.557\frac{1}{3}\frac{1}{2}$
(9.) \$162.535$\frac{1}{7}$. (10.) \$8.303$\frac{3}{4}$. (11.) $3\frac{1}{3}\frac{1}{2}$.
(12.) $\frac{2}{1}\frac{7}{6}\frac{5}{8}\frac{4}{8}\frac{0}{0}\frac{5}{5} = 1639\frac{5}{1}\frac{3}{6}\frac{3}{8}$. (13.) $\frac{1}{6}\frac{8}{5}\frac{2}{7}\frac{3}{5}\frac{4}{4}$.
(14.) $\frac{2}{5}\frac{1}{0}$ of an acre. (15.) $19\frac{1}{1}\frac{4}{0}\frac{8}{0}\frac{3}{0}$.

92. (3.) $\frac{2}{4}\frac{1}{0}$; $\frac{1}{9}\frac{0}{0} = 1\frac{1}{9}$; $\frac{9}{4}\frac{4}{4}$.
(4.) $\frac{1}{4}\frac{0}{0}\frac{2}{0}\frac{9}{0} = 2\frac{2}{4}\frac{2}{0}\frac{9}{0}\frac{9}{0}$; $289\frac{5}{8}$; $\frac{2}{4}\frac{1}{9}\frac{5}{9}$.

(5.) $\frac{1944}{911} = 2\frac{119}{911}$; $11\frac{1}{5}$; $\frac{13}{72}$. (6.) $\frac{13}{3}$; $\frac{154}{128}$; $2\frac{18}{91}$.
(7.) $1\frac{53}{209}$. (8.) $\frac{21}{25}$; $1\frac{1}{3}$; $\frac{264}{175} = 1\frac{89}{175}$.
(9.) $1\frac{3}{11}$; $22\frac{1}{2}$; $\frac{3}{20}$; $3\frac{11}{15}$. (10.) $\frac{16}{279}$; $\frac{8}{21}$; $\frac{8}{37}$; $1\frac{31}{60}$.
(11.) $1\frac{176}{840}$.

93. (2.) 23137 rd. 9 ft. 6 in.
(3.) 193 sq. rd. 8 sq. yd. 6 sq. ft. 108 sq. in.
(4.) 2287 na. $\frac{1}{4}$ in. (5.) 2230 yr. 260 da. 12 h.
(6.) 299,878 sq. rd. 21 sq. ft. 72 sq. in.
(7.) $329,576\frac{8}{17}$; $157,825\frac{24}{77}$; $3903\frac{8}{68}\frac{148}{17}$; $507\frac{367}{44}\frac{83}{31}$.

94. (13.) $23\frac{13}{15}$; $19\frac{21}{25}$; $29\frac{11}{37}$; 583.
(14.) 4.85714; 22.82432; 31900.0625; 156.29961.
(15.) Sum $10\frac{13}{24}$; diff. $3\frac{7}{24}$. (16.) Sum $40\frac{7}{48}$; diff. $8\frac{13}{48}$.
(17.) Sum $12\frac{95}{112}$; diff. $8\frac{81}{112}$. (18.) Sum $\frac{78}{140}$; diff. $\frac{19}{140}$.
(19.) $83\frac{17}{20}$; $146\frac{118}{259}$; $61\frac{223}{245}$.
(20.) 1 qr. 20 lb. 7 oz. $11\frac{14}{15}$ dr.
(21.) 16 gal. 1 qt. 0 pt. $3\frac{3}{10}$ gills. (22.) $2\frac{133}{280}$; $\frac{371}{864}$.
(23.) $\frac{263}{3136}$; $\frac{5}{117}$. (24.) $\frac{64}{121}$; $8\frac{677}{1138}$. (25.) $13\frac{10}{11}$; $1\frac{3}{7}$.
(26.) $10\frac{137}{840}$. (27.) $20\frac{347}{384}$. (28.) $\$47\frac{53}{112} = \$47.473\frac{3}{14}$.
(29.) $\$16.406\frac{1}{4}$. (30.) $\$20\frac{223}{1024} = \$20.223\frac{81}{128}$.
(31.) $\$474\frac{501}{1280} = \$474.391\frac{13}{32}$.
(32.) $£4\frac{33}{64} = £4$ 7s. 2d. 1qr. (34.) $16.40625.
(35.) $20.2236. (36.) $474.3914.
(37.) £4.359375 = £4 7s. 2d. 1qr.
(39.) $\$1.052\frac{1}{12} = \$1.052+$. (40.) $9\frac{3}{4}$ sq. ft. = 9.75 sq. ft.
(41.) $19\frac{37}{75} = 19.4743+$ yds.; $\$17\frac{21}{625} = \$17.04\frac{1}{156}$.
II. (42.) $38\frac{1}{4} = 38.25$ sq. ft.; $8\frac{193}{153}$ rolls $= 8.673+$ rolls.
(43.) Once; $13726\frac{58}{117}$. (44.) $199\frac{1}{48}$ bottles.
(45.) $45\frac{3}{10}$ bushels.
(46.) $9\frac{747}{5120}$ A. $= 9.1459-$ A.; $\$228\frac{331}{512} = \$228.647\frac{59}{128}$.
(47.) $\$1\frac{1}{9} = \$1.111\frac{1}{9}$; $\$8\frac{289}{512} = \$8.472\frac{9}{32}$.
(48.) $\$\frac{47}{224} = \$0.209\frac{23}{28}$. (49.) $75\frac{5}{8}$ cu. ft. $= 60\frac{344}{448}$ bu.
(50.) $294\frac{27}{32}$ cu. ft.; $2\frac{124}{409}\frac{3}{6}$ cords; $\$10\frac{2}{32}\frac{14}{76}\frac{14}{8} = \$10.653\frac{21}{40}\frac{87}{86}$.
(52.) 2 A. 3 R. 15 sq. rd. 18 sq. yd. 5 sq. ft. 36 sq. in.
(53.) 3 m. 23 rd. $3\frac{1}{2}$ yd. 2 ft. $=$ 3 m. 23 rd. 4 yd. 0 ft. 6 in.
(54.) 9 m. 4 fur. 29 rd. 5 yd. 1 ft. 4 in.
(55.) 22 A. 3 R. 1 sq. rd. 30 sq. yd. 1 sq. ft. 108 sq. in.; 34 A. 0 R. 22 sq. rd. 30 sq. yd. 1 sq. ft. 72 sq. in.
(56.) 2 R. 11 sq. rd. 12 sq. yd. 8 sq. ft. $97\frac{1}{7}$ sq. in.
(57.) 62 m. 3 fur. 19 rd. $1\frac{1}{2}$ yd. 2 ft. $=$ 62 m. 3 fur. 19 rd. 2 yd. 0 ft. 6 in.; 93 m. 5 fur. 9 rd. 0 yd. 1 ft. 6 in.
(58.) 54 A. 2 R. 38 sq. rd. $22\frac{1}{2}$ sq. yd. 2 sq. ft. 8 sq. in. $=$

54 A. 2 R. 38 sq. rd. 22 sq. yd. 6 sq. ft. 80 sq. in.; 164 A. 0 R. 36 sq. rd. 7 sq. yd. 6 sq. ft. 24 sq. in.

(59.) 1 yd. 1 ft. 5.46 in.

(60.) 1 sq. rd. 15 sq. yd. 8 sq. ft. 32.63 sq. in.

(61.) 12 sq. yd. 5 sq. ft. 14.0544 sq. in.

(62.) 5 A. 1 R. 12 sq. rd. 2 sq. yd. 5 sq. ft. 83.0664 sq. in.

(63.) 68 cu. yd. 5 cu. ft. 648.1728 cu. in.

95. (18.) \$35.50; \$67.45; \$88.75; \$108.27½.

(19.) $12\frac{12}{35}$ min.

(20.) 10 da.; $6\frac{2}{3}$ da.; $3\frac{11}{23}$ da.; $3\frac{1}{5}$ da.; 80 men; 16 men; 8 men; 5 men.

(21.) 50 da.; 5 da.; $8\frac{1}{3}$ da.; 4 da. (23.) $\$3\frac{1}{7} = \$3.571\frac{3}{7}$.

(24.) \$5.625. (25.) $\$50.459\frac{2}{2}\frac{3}{8}$; $\$79.861\frac{1}{2}\frac{7}{8}$.

(26.) \$92; $\$268.33\frac{1}{3}$.

(27.) $\$51.56\frac{1}{4}$; $\$73.66\frac{1}{1}\frac{1}{4}$; $\frac{1}{5}\frac{1}{5}$ wk.; $\frac{8}{5}\frac{8}{5}$ wk.; $4\frac{2}{5}$ wk.

(28.) $18\frac{3}{2}\frac{3}{0}$ rods. (29.) $50\frac{5}{8}$ bu.

(30.) $28\frac{1}{8}$ lb.; 30 lb.; $42\frac{3}{1}\frac{3}{6}$ lb. (31.) $49\frac{7}{2}\frac{7}{5}$ yd.

(32.) $121\frac{1}{3}$ ft.; $110\frac{1}{1}\frac{1}{5}$ ft.; $93\frac{1}{2}\frac{1}{4}$ ft.

(33.) 12 men; 36 men; 18 men; 6 men; 4 men.

(34.) $\frac{5}{8}$ of it = 45 cts.; he has spent $\frac{9}{7}\frac{1}{2}$ of his money; he has 11 cts. left.

(35.) \$2.40; 30 cts. for coffee; \$1 for sugar; 40 cts. for rice; 50 cents for molasses. (36.) 120. (37.) 56.

(38.) 144; viz., 54 bear apples; 24 cherries; 6 quinces; and 30 peaches.

SECTION IX.

96. (1.) 25 and 15. (2.) 50 and 15; 27 and 13; $4\frac{1}{2}$ and $3\frac{1}{2}$; $8\frac{1}{8}$ and $4\frac{7}{8}$; $15\frac{1}{7}$ and $6\frac{4}{7}$.

97. (1.) 5. (2.) $5\frac{1}{2}$; $3\frac{2}{3}$. (3.) $5\frac{3}{4}$; $4\frac{17}{36}$. (4.) $94\frac{1}{4}$.

(8.) $5 + 7 + 25$. (9.) $5 + 7 + 25$. (10.) $(4^2 \times 3) + (4 \times 3 \times 7) + 7^2$.

98. (1.) 8. (2.) $5\frac{7}{2\,4}$; $8\frac{7}{1\,5}$; $3\frac{2\,3}{3\,5}$; $2\frac{3\,7}{4\,5}$.

99. (1.) 12 in.; 24 in.; 36 in.; 144 in.; 18 in.; 8 in.

(2.) 12 ft. (3.) 12 ft.; $4\frac{1}{5}$ ft.; $7\frac{1}{5}$ ft.; $19\frac{2}{5}$ ft.

(4.) 16 rd.; 8 rd.; 4 rd.; 40 rd.; 80 rd.; 160 rd.

(5.) 2 yd.; 4 yd.; $1\frac{1}{3}$ yd.; $1\frac{1}{2}$ yd.; $\frac{2}{3}$ yd.

(6.) 21 yd.; 30 yd.; 18 yd

(7.) $27\frac{9}{3\,7}$ in.; $42\frac{3\,0}{3\,7}$ ft.; $223\frac{2\,8}{3\,7}$ in.

(8.) $33\frac{1}{3}$ rods; $25\frac{7}{8}\frac{1}{3}$ rd.; $22\frac{2}{2}\frac{3}{9}$ rd.
(9.) $1\frac{4}{3}\frac{2}{6}\frac{1}{1}$. (10.) $35\frac{3}{16}$; $12\frac{1}{1}\frac{5}{3}$.
(11.) $59\frac{13}{16}$ and $26\frac{1}{16}$; $15\frac{1}{12}$ and $33\frac{2}{17}$. (12.) 4 ft.
(13.) $35\frac{1}{5}$ ft.

SECTION X.

100. (2.) \$18.50; \$27.75; \$37.00; \$46.25; \$55.50; \$74.00; \$83.25; \$92.50; \$111.00; \$129.50; \$166.50.
(5.) $\$12.593\frac{3}{4}$. (6.) $\$35.39\frac{1}{5\,6}$; $\$8.023\frac{7}{1\,6}$; $\$5.014\frac{3}{7}$.
(7.) \$341.25; $\$467.578\frac{1}{8}$; $\$303.515\frac{5}{8}$.

101. (4.) 2740; 4370; 4785; 8420; 12,850; 12,950; 16,880; 20,435; 26,795.
(5.) 200; 300; 500; 425; 525; 550; 850; 1175; 3600; 6875; 14,375; 14,400; 16,200; 4625; 16,700; 18,850; 80,400; 100,900.
(6.) 400; 600; 1000; 850; 1050; 1100; 1700, 2350; 7200; 13,750; 28,750; 28,800; 32,400; 9250; 33,400; 37,700; 160,800; 201,800.
(7.) 100; 150; 250; 212.5; 262.5; 275; 425; 587.5; 1800; 3437.5; 7187.5; 7200; 8100; 2312.5; 8350; 9425; 40,200; 50,450.
(8.) 1000; 1500; 2500; 2125; 2625; 2750; 4250; 5875; 18,000; 34,375; 71,875; 72,000; 81,000; 23,125; 83,500; 94,250; 402,000; 504,500.
(9.) $266\frac{2}{3}$; 400; $666\frac{2}{3}$; $566\frac{2}{3}$; 700; $733\frac{1}{3}$; $1133\frac{1}{3}$; $1566\frac{2}{3}$; 4800; $9166\frac{2}{3}$; $19,166\frac{2}{3}$; 19,200; 21,600; $6166\frac{2}{3}$; $22,266\frac{2}{3}$; $25,133\frac{1}{3}$; 107,200; $134,533\frac{1}{3}$.
(10.) 6; 9; 16; 20; 27; 10.8; 23.04; 15.36; 39.6; 63; 65.6; 129.92; 182.56; 326.68.
(11.) 1.2; 1.8; 3.2; 4; 5.4; 2.16; 4.608; 3.072; 7.92; 12.6; 13.12; 25.984; 36.512; 65.336.
(12.) 12; 18; 32; 40; 54; 21.6; 46.08; 30.72; 79.2; 126; 131.2; 259.84; 365.12; 653.36.
(13.) 3; 4.5; 8; 10; 13.5; 5.4; 11.52; 7.68; 19.8; 31.5; 32.8; 64.96; 91.28; 163.34.
(14.) 4.5; 6.75; 12; 15; 20.25; 8.1; 17.28; 11.52; 29.7; 47.25; 49.2; 97.44; 136.92; 245.01.
(16.) 463,383; 5,097,213; 51,435,513; 5,148,648,513.
(17.) 1,857,740; 9,288,700; 18,577,400; 4,644,350; $12,384,933\frac{1}{3}$; 46,443,500.
(18.) 16,787.36; 3357.472; 33,574.72; 8393.68; 12,590.52.

(19.) 2,574,350; 643,587.5; 1,716,233⅓; 1,287,175; 6,435,875; 257,435.
(20.) 18,325.2; 12,216.8; 48,867.2; 4886.72; 24,433.6.

SECTION XI.

102. (9.) $0.69; $1.61; $3.45; $5.75; $43.01; $233.68; $2.3368.
(10.) $0.4875; $0.8625; $151.51275.
(11.) 6.46\frac{7}{8}$; 140.28\frac{3}{4}$; 189.40\frac{5}{16}$. (12.) 262.5 lb.
(13.) $75.00; 145.93\frac{3}{4}$; $252.00.
(15.) 5.4741\frac{1}{4}$; 54.74444\frac{4}{9}$. (16.) $7.09675; $5.4306.
(17.) $711.585. (18.) $1125.00. (19.) 2187.50.
(20.) $0.17437. (21.) $\frac{3}{5} = 60$ per. cent.
(22.) $\frac{35}{61} = 57\frac{23}{61}$ per cent. (23.) $\frac{121}{2015} = 6\frac{2}{13\frac{1}{3}}$ per cent.
(24.) $1\frac{1}{55}$ per cent.; $2\frac{19}{20}\frac{12}{65}$ per cent.; $\frac{220}{413}$ of 1 per cent.; $97\frac{39}{413}$ per cent. (25.) $2\frac{1}{2}$ per cent.

103. (1.) $46.875. (2.) $41.2776. (3.) $2.195.
(4.) £1 17s. 7¼d. (5.) £21 17s. 7¾d.; £16 13s. 5¼d.

104. (1.) $34.375. (2.) $109.375. (3.) $33.96.

105. (1.) $506.875; $513.125; $494.375; $491.875.
(2.) $42. (3.) $3806.25. (4.) $95.
(5.) 231.71\frac{3}{7}$; 234.57\frac{1}{7}$; 226.85\frac{5}{7}$. (6.) $5.

106. (3.) E's $12.72; F's $24.97; G's $15.58.
(4.) $29.35; $14.53. (5.) $214.50. (6.) $5500.
(7.) Real estate $1500; Personal estate $1200.

107. (2.) $86.64. (3.) $103.65.
(4.) $357.47; per gallon $2\frac{86}{100}$ cts.
(5.) $7.10. (6.) $5049.76.

108. (10.) 0.049\frac{1}{6}$; 0.079\frac{2}{3}$; $0.225.
(11.) 0.338\frac{1}{3}$; 0.239\frac{1}{6}$; 0.248\frac{1}{4}$.
(13.) $3.67697; $10.45289; $13.55985; $16.35371.
(14.) $498.825; $203.7854; $401.6606; $953.4415.
(15.) $2598.4407; $4114.67196; $2387.95536.
(16.) $3.3705; $2.7577; $4.2898; $4.5962; $5.51546; $7.66036; $1.9917.
(17.) $0.66591; $3.619826; $20.844492; $6.8669.
(18.) $24.96; $22.88; $27.04; $29.12; $34.67.

(21.) $50.7925; $57.1416; $84.654; $112.167.
(22.) $228.566; $273.5868; $318.6075.
(23.) $701.2828; $813.83437; $1030.2796875.
(24.) $0.666—; $1.674; $3.36127.
(25.) $83.914; $113.483; $82.789625.
(27.) £6 7s. 9d.; £1 7s. 3¼d.; £208 8s. 5¾d.; £0 11s. 6¾d.

109. (2.) $374.40. (3.) $16.25. (4.) $78.67.
(5.) $460.42. (6.) $716.68.

110. (1.) $142.71. (2.) $511.17. (3.) $76.92.
(4.) $457.83. (5.) $160.47, balance due to Burnham.
(6.) $332.31, due Farmer. (7.) $129.32, due Stetson.

111. (3.) $226.75; $229.87; $231.76.
(4.) $596.47; $605.97. (5.) £113 1s. 6½d.

112. (2.) 10 per cent.; $5\frac{3}{10}$ per cent.
(4.) 1 yr. 10 mo. 18 da.
(5.) 16 yr. 8 mo.; 12 yr. 6 mo.; 13 yr. 4 mo.
(6.) 16 yr. 8 mo.; 12 yr. 6 mo.; 13 yr. 4 mo.; 22 yr. 2 mo. 20 da.; 6 yr. 8 mo. (8.) $2727.27. (9.) $1313.13.
(11.) $923.79. (12.) $711.67. (13.) $133.93.
(14.) $418.41; $384.62; $393.70; $439.56.
(15.) $82.64; $81.47; $83.86; $78.13.

113. (1.) $15. (2.) $16.33; $333.67.
(3.) $955. (4.) $564.13. (5.) $119.375. (6.) $0.34½.
(7.) $89.53.

116. (1.) $2.75; $497.25. (2.) $563.21.
(3.) $298.70. (4.) $148.225. (5.) $460.12.
(6.) $395.67.

117. (1.) $505.31. (2.) $355.51; $356.45; $357.40.
(3.) $1010.61; $1008.83. (4.) $455.93.

118. (2.) $253.62. (3.) $3465.38. (4.) $199.

119. (1.) $88; $90; $96. (2.) $.36; $.44; $.32.
(3.) $5.40; $5.60; $5.75. (4.) 20 per cent.; 20 per cent.
(5.) 4 per cent.; 20 per cent.; 40 per cent.; gain, 4 per cent.; 8 per cent.; 20 per cent.
(6.) 4 per cent.; 8 per cent.; 2 per cent.; 5 per cent.
(8.) 24 cts. (9.) 70 cts. (10.) 63 cts. (11.) $4.

(12.) $3.50. (13.) 12½ per cent. (14.) $5. (15.) $4.
(16.) 15 per cent. (17.) $2\frac{84}{100}$ per cent. (18.) $7\frac{7}{10}$ per cent.
(19.) 26⅔ cts. (20.) 30 per cent. (21.) $58\frac{1}{27}$ cts.
(22.) Gain, 15 per cent.; 23⅓ per cent.
(23.) Neither; gain, 4 per cent. (24.) 16⅔ per cent.
(25.) $.60. (26.) 9⅜ per cent.

120. (2.) 4 mo. 12 da. (5.) April 20.
(6.) 37 da. after Oct. 1, — Nov. 7.
(7.) 13 da. after Nov. 10th, — Nov. 23d. (8.) May 11.
(9.) Sept. 26. (10.), May 16.

121.

(1.) £121 12s. 3d. sterling; £135 2s. 6d. Canada; £162 3s. 0d. N. Eng.; £216 4s. 0d. N. York; £202 13s. 9d. Penn.; £126 2s. 4d. Georgia.

(2.) $232.815 sterling; $209.533 Canada; $174.611 N. Eng.; $130.958 N. York; $139.689 Penn.; $224.500 Georgia.

(3.) 5s. 7½d. sterling; 6s. 3d. Canada; 7s. 6d. N. England; 10s. 0d. N. York; 9s. 4½d. Pennsylvania; 5s. 10d. Georgia.

(4.) $1.666 sterling; $1.50 Canada; $1.25 N. England; $0.93¾ N. York; $1.00 Pennsylvania; $1.607 Georgia.

122. (2.) $4.84\dot{4}$; $82.35\dot{5}$; $4.037; $81.81; $38.87.
(3.) 4s. 1.09d.; £3 3s. 5d.; £35 19s. 3¾d.
(4.) £20 13s. 9½d.; £11 6s. 6½d.; £325 17s. 3d.
(5.) $483.33⅓; $366.986; $7252.115.

123. (1.) 93 cts. (2.) $9.52½; $11.58¾.
(3.) $38\frac{4}{67}$ cts.; $59\frac{42}{67}$ cts. (4.) $3.26\frac{4}{7}$; $5.16\frac{12}{35}$.
(5.) $7\frac{1}{2}$ A.; $11\frac{43}{160}$ A.; $17\frac{53}{60}$ A. (6.) $39.41⅜; $65.08⅓.
(7.) $7.06\frac{62}{127}$; $2.91\frac{83}{97}$; $8.69\frac{11}{41}$.
(8.) $49.21\frac{37}{53}$; $187.88\frac{97}{106}$; $333.21\frac{13}{53}$.
(9.) $4.25\frac{25}{67}$; $3.44\frac{24}{25}$; $8.18\frac{34}{67}$. (10.) $9552.
(11.) $9600; $7200; $8000. (12.) $303.37\frac{7}{89}$.
(13.) 18¾ gallons. (14.) 87⅝ bu. (15.) 203¼ lb.
(16.) 170 bu. (17.) $712.50.
(18.) $214, @ 25 cts.; $285.33⅓, @ 33⅓ cts.; $321, @ 37½ cts.; $428, @ 50 cts.; $107, @ 12½ cts.; $642, @ 75 cts.; $749, @ 87½ cts.

(19.) £356 5s.; £867 14s. 2d. (20.) $\$174.89\frac{1}{16}$.
(21.) 300. (22.) $472\frac{1}{2}$.
(23.) $3\frac{1}{15}$ miles; $3\frac{23}{88}$ miles; $58\frac{8}{15}$ miles; $51\frac{13}{60}$ miles.
(24.) $77\frac{17}{20}$ hours; $5\frac{55}{439}$ hours.
(25.) $\frac{1}{2}$ and $\frac{1}{3}$; $\frac{1}{6}$ of it; 1 h. 12 min.
(26.) 55 min. $23\frac{1}{13}$ sec. (27.) 1 h. 42 min. $51\frac{3}{7}$ sec.
(28.) 40 min.
(29.) The water will run out just as fast as it runs in.
(30.) $\$769.23\frac{1}{13}$; $\$784.31\frac{9}{51}$.
(31.) 10 per cent.; $6\frac{1}{4}$ per cent. (32.) $8\frac{1}{3}$ yr.
(33.) $12\frac{1}{2}$ per cent. (34.) $250; $270. (35.) 2 hours.

124. (1.) $71.61; $77.57; $83.54; $89.51; $101.44; $53.71; $62.66.
(2.) $78.64 by the legal rule; $78.36 by the common rule.
(3.) He gains $\$47.59 = 4\frac{759}{1000}$ per cent.; gains $33.88.
(4.) $1332.50; $1238.25; $1459.25.
(5.) $454.55—; $515.464; $523.56; $588.24; $651.47; $489.00; $474.50.
(6.) $\$.29\frac{113}{352}$; $\$.28\frac{122}{352}$; $\$.27\frac{105}{657}$; $\$.28\frac{99}{352}$.
(7.) He gains $55.79; loses $75.65; gains $6.50.
(8.) $0.30—, $.282. (9.) $32.50.
(10.) $\$.73\frac{1}{3}$; $\$.76\frac{2}{3}$; $.75. (11.) $6\frac{36}{100}$ per cent.
(12.) Cash price, $3107.51; $8.53 per 100 lb.
(13.) $8.96 per 100 lb. (14.) $1150.43. (15.) $279.99.
(16.) $278.59. (17.) $2441.48; $2179.90.
(18.) $2460.88; $2197.21.
(19.) $2437.14; $2414.89; $2420.45; $2439.93.
(20.) £207 7s. $5\frac{1}{2}$d.; £208 16s. 4d.; £205 19s.; £204 10s. $10\frac{3}{4}$d.
(21.) $486.83; 483.54; $476.96; $473.67.
(22.) $690.49 — $11.30 = $679.19.
(23.) $466.08 — $9.77 = $456.31.
(24.) Amount, $1346.00; cash, $1271.97.
(25.) Amount, $691.20; cash proceeds, $670.46.
(26.) Note dated Oct. 13th, for $743.61. Balance, $244.75.

125. (5.) Feb. 24th. (6.) Jan. 5th.
(7.) Oct. 28, 1848; Aug. 29, 1849.
(8.) April 17, 1850; Nov. 9, 1850.
(9.) 146 days after July 30th, or Dec. 23, 1848.
(10.) 147 days after Sept. 16th, or Feb. 10th, 1849.

(11.) $175.29; $175.26. (12.) $252.87; $252.79.
(13.)* Balance of interest, $4.88; balance of account, $354.88.
(14.) Balance of interest, $13.08; balance of account, $1001.82.

SECTION XII.

126. (1.) $\frac{7}{3}$ or 7 : 3; $\frac{8}{5}$ or 8 : 5; $\frac{5}{9}$ or 5 : 9; $\frac{9}{16}$ or 9 : 16; $\frac{87}{150}$ or 87 : 150; $\frac{16}{9}$ or 16 : 9.
(2.) $\frac{9}{2}$ or 9 : 2; $\frac{2}{9}$ or 2 : 9; $\frac{5}{3}$ or 5 : 3; $\frac{5}{3}$ or 5 : 3; $\frac{3}{5}$ or 3 : 5; $\frac{7}{3}$ or 7 : 3; $\frac{16}{3}$ or 16 : 3.
(3.) $\frac{7}{8}$; $\frac{15}{24} = \frac{5}{8}$; $\frac{5}{7}$; $\frac{19}{27}$; $\frac{5}{8}$. (4.) $\frac{16}{15}$; $\frac{32}{35}$; $\frac{4}{35}$; $\frac{8}{50}$; $\frac{168}{245}$.

127. (1.) 63; 128; $19\frac{1}{4}$; 45; $4\frac{4}{5}$; $22\frac{1}{2}$; $50\frac{2}{3}$.
(2.) $6\frac{2}{5}$; 48; $30\frac{20}{69}$; $3\frac{15}{17}$. (3.) $12\frac{198}{205}$; $\frac{19}{25}$; $27\frac{6}{7}$; $4\frac{1}{2}$.
(4.) $6\frac{3}{7}$; $1\frac{28}{36}$; $219\frac{3}{13}$. (5.) $3\frac{11}{240}$; $1\frac{119}{225}$; $4\frac{407}{832}$.
(6.) $3\frac{3}{5}$; $6\frac{3}{7}$; $\frac{55}{72}$. (7.) $40; $45\frac{5}{6}$ cts.; $1\frac{11}{64}$ cts.
(8.) 6.09\frac{3}{8}$; 16.96\frac{3}{7}$.
(9.) $\$\frac{8}{35} = \$0.22\frac{8}{7}$; $8.16; $\$\frac{13}{25}\frac{4}{6} = \$0.52\frac{47}{64}$.

128. (2.) 8 days. (3.) $4432.50. (4.) $360.
(5.) 35 days. (6.) 25 days. (7.) 7 men. (8.) 27 pairs.
(9.) $94.50. (10.) $107.10. (11.) $\frac{3}{7}$ bbl. (12.) $11\frac{2}{3}$ yds.
(13.) $4687\frac{1}{2}$ lb.; $5906\frac{1}{4}$ lb. (14.) 104.29\frac{1}{6}$.
(15.) 7 per cent. (16.) $3\frac{1}{5}$ yr. (17.) $162\frac{1}{15}$ ft.; $69\frac{3}{13}$ ft.
(18.) £18 18s.; 35 yds. (20.) 28 cts. (21.) $1.57\frac{1}{15}$.
(22.) $15\frac{25}{52}$ da. (23.) $15\frac{47}{80}$ yds. (24.) $3\frac{1}{3}$ days.

129. (1.) 12 : 35; 9 : 25; 27 : 272; 128 : 81.

130. (1.) $14\frac{14}{15}$; $37\frac{11}{12}$; 8. (2.) $13\frac{11}{25}$; $9\frac{183}{192}$; 24; $1\frac{1}{2}$.
(3.) $3\frac{13}{16}$ wks. (5.) $7\frac{1}{2}$ da. (6.) 224 bu. (7.) 40 da.
(8.) $20. (9.) 2 da. (10.) $4\frac{2}{3}$ da. (11.) 100 men.
(12.) 32.14\frac{2}{7}$. (13.) 12 more men. (14.) $57\frac{43}{69}$ days.
(15.) 1125 men. (16.) 24 lb. (17.) $288\frac{58}{207}$ da.
(18.) $2170; $2185. (19.) £207. 7s. $5\frac{1}{2}$d.; £205 18s. $11\frac{3}{4}$d.

131. (3.) 120 acres. (4.) $336.60. (5.) $6\frac{2}{5}$ da.
(6.) $44,296\frac{7}{8}$ lb. (7.) $103.33\frac{1}{3}$.
(8.) $1\frac{114}{109}$ yr. = 1 yr. 2 mo. 8.4 da. (9.) $5\frac{1}{2}$ per cent.
(10.) $13\frac{7}{11}$ barrels. (11.) $109\frac{3}{8}$ ft.

* See page 165—last two lines.

132. (2.) 7¼ barrels; $126. (3.) $.27⅛; 14⅖ oranges.
(4.) 140 florins. (5.) $5009.71.
(6.) $143.04 better to buy a bill.

133. (3.) A $\frac{9}{31}$; B $\frac{10}{31}$; C $\frac{12}{31}$; — A $72; B $80; C $96; — A $27; B $30; C $36.
(4.) $\frac{4}{13}$; $\frac{3}{13}$; $\frac{6}{13}$; — A $360; B $300; C $180; — A $120; B $100; C $60.
(5.) 32 per cent.; — A $512; B $576; C $816; D $384.
(6.) $255; $212.50; $170; $127.50; $85.
(7.) A $30; B $45. (8.) $120; $90; $135.
(9.) $119.68; $143.62; $287.23; $199.47.
(10.) A $\frac{18}{48}$, B $\frac{24}{48}$; A $9.24, B $10.76. (11.) $400.
(12.) A $156.86; B $294.12; C $225.49; D $323.53.

134. (2.) A $\frac{24}{50}$ = $20.34; B $\frac{25}{50}$ = $29.66.
(3.) A $260.87; B $456.52; C $782.61.
(4.) A $564.26; B $634.80; C $300.94.
(5.) A $874.64; B $699.71; C $925.66.
(6.) A $244.02; B $268.43; C $362.55.

135. (1.) 18, 36, and 108 miles. (2.) 8, 24, and 120.
(3.) A $600; B $1500; C $2100.
(4.) Horse $120; carriage $480. (5.) 9 of each.
(6.) 8 men; 24 boys.
(7.) 12 @ $1; 8 @ 75 cts.; 6 @ 50 cts.
(8.) A 7 pieces; B 1 piece. (9.) 8 weeks.
(10.) Father 35 yrs.; son 7 yrs. (11.) 4 of each.
(12.) 5 cows; 15 calves; 30 sheep.
(13.) 16; 32; 120; 168. (14.) 24 and 180. (15.) $3200.
(16.) 6 min. 40 sec. (17.) 1200. (18.) $3\frac{4}{3}$ da.
(19.) 58⅓ A. (20.) $123\frac{7}{15}$ bu.; $27.71 cash.

136. (1.) $\frac{1005}{656}$; $\frac{171}{3602}$. (2.) $\frac{166}{195}$; $\frac{847}{330}$. (3.) $\frac{10}{1}$; $\frac{8}{38000}$.
(4.) 30 : 7. (5.) 33902 : 8277. (6.) $22\frac{1}{17}$. (7.) 15000.
(8.) 441 lb. (9.) 378 men. (10.) 50 more men.
(11.) A $1800; B $2250; C $5100.
(12.) C's share $\frac{23}{60}$; A pays $1350; B $2000.
(13.) $22\frac{19}{21}$ bbl. (14.) 100 lb.
(15.) A $80.12; B $106.83; C $178.04; D $115.73; E $519.29.
(17.) A $506.85; B $185.48; C $182.67.
(18.) A $68.10; B $108.97; C $119.19; D $153.24; $6\frac{8}{100}$ per cent.

137. (2.) \$0.50$\frac{25}{37}$. (3.) 17 carats fine.
(4.) $20\frac{17}{22} = 20\frac{3}{4}$ yds. nearly. (5.) \$2.18$\frac{2}{3}$.

138. As most of the questions in this article admit of an indefinite number of answers, no answers are inserted here to the first seven questions. The learner will prove his answers to be correct.
(8.) 200 lb. at 8 cts., and 100 lb. at 11 cts.
(9.) $533\frac{1}{3}$ lb. at 15 cts., and $266\frac{2}{3}$ lb. at 20 cts.
(10.) Indefinite.

139. (1.) 15 ft. 11′ 4″; 2 9′ 4″; 11 6′; 5 7′ 11″ 4‴ 6⁗; 54; 25 6′ 8″ 6‴.
(2.) 10 3′ 10″ 2‴; 7 0′ 2″ 8‴ 0⁗ 4⁗′.
(3.) 10 ft. 2′ 8″; 21 ft. 8′ 8″; 57 ft. 9′.
(4.) 240 ft. 9′ 4″. (5.) 70 ft. 11′. (6.) 1005 ft. 4′ 4″.
(7.) 139 ft. 11′ 10″. (8.) 155103 cu. in. = 72 bu. $4\frac{9}{112}$ qt.
(9.) $59\frac{23}{27}$ sq. yd.
(10.) 484 cu. ft. 7′ 2″ = 3 C. 6 C. ft. $44\frac{3}{72}$ cu. ft.

140. (6.) 8; 125; 1225.
(7.) 2916; 17.64; 521.660125.
(8.) $878\frac{23}{65}$; $24\frac{3}{61}$; $52\frac{7}{64}$; 616.295051.

143. (2.) 35; 49; 87. (3.) 125; 729; 1024.
(4.) 4519; 6044; 8528. (5.) 3.5; 4.9; .87.
(6.) 72.9; 7.29; 1.25; 10.24. (7.) 45.19; 14.29+.
(8.) $\frac{3}{4}$; $\frac{18}{24} = \frac{3}{4}$; $\frac{35}{67}$. (9.) $3\frac{1}{2}$; $22\frac{1}{2}$; $3\frac{4}{5}$.
(10.) 1.7512—; 5.0035+; 4.9296+; 212.5201. (11.)*

145. (2.) 43; 51; 89. (3.) 104; 306; 342.
(4.) 409; 783; 808. (5.) 9.31786; 6.694329; 1.6016
(6.) 6.986368; 3.7799. (7.) $\frac{2}{3}$; $\frac{7}{9}$; $\frac{18}{22}$.
(8.) $\frac{7}{3} = 2\frac{1}{3}$; $\frac{15}{4} = 3\frac{3}{4}$; $\frac{29}{17} = 1\frac{12}{17}$.
(9.) .7211248.; .3816; .0941. (10.) 2.4779; 2.6324.

146. (1.) 44. (2.) 30. (3.) 78. (4.) 144. (5.) 25.
(6.) 33. (7.) $\frac{45}{29} = 1\frac{16}{29}$. (8.) 607. (9.) 98. (10.) 450.
(11.) 40. (12.) 44. (13.) $\frac{1}{4}$. (14.) $\frac{27}{578}$. (15.) $\frac{209}{578}$.
(16.) $184\frac{3}{59}$. (17.) 16.8. (18.) $135\frac{19}{36}$. (19.) $19\frac{83}{864}$.
(20.) 20. (21.) 7 — 5.7388 = 1.2612. (22.) $\frac{9}{14}$.
(23.) $4\frac{1}{2}$.

147. (1.) 5; 8; 14; 29. (2.) 18; 38; 73; 98.
(3.) 241.5 ft.

* See page 2d.

(4.) $106; $112; $130; $148. The first term is the principal; the com. diff. is the interest for 1 year; the last term is the amount for 8 years.

(5.) 5. (6.) 3 years. (7.) 114. (8.) 78 times.

(9.) 300 times. (10.) 144.9 ft.; 579.6 ft.; 1030.4 ft.

(11.) $15. (12.) $798. (13.) 4 diff.; 351 revolutions.

(14.) 198.

148. (1.) $428; — second term $51; com. diff. $1; number of terms 8; last term $57; sum $428.

(2.) $560; — com. diff. $6; number of terms 5; last term $124; sum $560.

(3.) $1905. (4.) $2175. (5.) $320.62½.

149. (2.) $196.83. (3.) $31.877. (4.) $1710.34..

(5.) 43,740. (7.) 349,525. (8.) $177,147; $265,720.

150. (1.) $5.637. (2.) 628.895.

(3.) $149.716; $142.068. (4.) $2030.37.

(5.) $1277.24 — $1257.79 = $19.44. (6.) $203.802.

(7.) $241.554; $356.094. (8.) $736.009.

(9.) $2492.442. (10.) $1104.01.

(11.) $4151.86, the widow's; $1485.71, the son's.

(12.) Widow's, $3088.69; son's, $1896.19; — widow's, $1731.79; son's, $2420.07.

SECTION XVIII.

153 — 163. (1.) 10 A.; 1 A. 1 R. 25 sq. rd.; 2 A. 2 R. 20¼ sq. rd.; 2 A. 27 sq. rd. 9 sq. yd. 4 sq. ft. 72 sq. in.; 32 sq. rd. 3 sq. yd. 3 sq. ft. 36 sq. in.

(2.) 30 rods; 49 rods nearly; 63.24555 rd. = 63 rd. 4ft. .6 in. (3.) 19 ft. (4.) 245⅛ ft.

(5.) 1½ A.; 15.4919 rd. (6.) 274⅔ sq. yd. (7.) 3420 sq. ft.

(8.) 15⅝ sq. ft.; 12½ sq. ft.; 30 sq. ft.

(9.) 90 sq. rd. (10.) 150 sq. rd.

(11.) 290.4737 + 374.53 + 187.0829 = 852.0866 sq. rd. = 5 A. 1 R. 12 sq. rd. 2 sq. yd. 5 sq. ft. 83.066 sq. in.

(12.) 1 A. 18 sq. rd. 2 sq. yd. (13.) 5317.3 sq. ft.; $531.73.

(14.) 107531.25 sq. ft. (15.) 1931.2 sq. yd.

(16.) 47.124 in.; 78.54 in.; 72.2568 ft.; 37.6992 ft.

(17.) 7.957 ft.; 11.7774 ft. (18.) 188.496 ft.

(19.) 1 sq. ft. 32.715 sq. in.; 3 sq. ft. 58.875 sq. in.; 415-.4766 sq. ft. = 1 sq. rd. 15 sq. yd. 8 sq. ft. 32.63 sq. in.; 113.0976 sq. ft. = 12 sq. yd. 5 sq. ft. 14.0544 sq. in.

(20.) 1 sq. ft. 88.048 sq. in.

(21.) 14.273— rd.; 7.1365 rd.; 28.546 rd.

(22.) 376.992 = 47 sq. yd. 7.992 sq. ft. = 1 sq. rd. 11 sq. yd. 5.742 sq. ft.

(23.) 942.48 sq. yd. = 31 sq. rd. 4 sq. yd. 6 sq. ft. 82.08 sq. in.

(24.) 36.0555 ft. (25.) 19.209 ft. (26.) 70.71 ft.

(27.) 11.3137 ft. (28.) 38.184 sq. ft.

164. (1.) 1 sq. in.; 4 sq. in.; 9 sq. in.; 16 sq. in.; 25 sq. in. (2.) 4 times; 9 times; 16 times; 25 times.

(3.) 3 sq. ft.; 12 sq. ft.; 27 sq. ft.; 48 sq. ft.; 75 sq. ft.; 300 sq. ft. (4.) 4 times; 9 times; 16 times; 25 times.

(5.) 12; 48; 108; 300.

(6.) 4 times; 9 times; 16 times; 25 times.

(8.) 2 in.; 4 sq. in.; 3.1416 sq. in.

(9.) 3 in.; 9 sq. in.; 7.0686 sq. in. (10.) 4 to 9.

(11.) 8 gal.; 12½ gal.; 18 gal.; 21⅛ gal.

(12.) 3 in. tube; 4½ in. tube; 6 in. tube.

(13.) 4.254 ft. to cut off $\frac{5}{12}$ from the top, or 2.835 ft. to cut it off from the base.

(14.) The upper part would contain ¼ of the whole triangle, and the lower ¾ of it. (15.) 2450 threads.

(16.) 263¼ lb.; 5 inches. (17.) 37⅞ sq. rd. (18.) 186⅔ feet.

(19.) 3.515 ft.; 2.202 ft.; 5.072 ft.

165. (1.) 39 ft. (2.) 21.2132 ft. (3.) 14.142 ft.

(4.) 500 sq. ft.; 32.015 ft. (5.) 78.1025 miles.

(6.) Charles and James, 180.277 rods; James and William, 125 rods; William and Henry, 213.6 ft.; Charles and William, 225 rods; James and Henry, 300 rods. (7.) 10 ft.

(8.) 254.4696 sq. rd.; 1017.8784 sq. rd.; 63.6174 sq. rd.; 7.0686 sq. rd.

(9.) 57.092— rods; 114.184— rods; 28.546 rods; 14.273 rods. (10.) 18.02 ft. (11.) $202.50; $135; 9.6047— rods.

(12.) 2⅛ inches. (13.) 823⅕ lb.; 1372 lb.; $85.75.

(14.) 22.136. (15.) 15.4919 rods. (16.) 278.28 yards.

(17.) 44 rods. (18.) 215.4066 ft. (19.) 18.35756.

(20.) 124.7076.

(21.) 17 ft. $3\frac{3}{8}$ in. nearly.; 2 ft. 10.56 in.; 3 ft. 5.47 in.
(22.) 1 in.; .7071068 in.; 29.69848. (23.) 2312 sq. in.
(24.) 452.39 — 288 = 164.39.
(25.) 576 — 452.39 = 123.61.

SECTION XIX.

167—180. (1.) 1350 sq. in. = 9 sq. ft. 54 sq. in.
(2.) 600 sq. in. = $4\frac{1}{6}$ sq. ft.; 1944 sq. in. = $13\frac{1}{2}$ sq. ft.; 27744 sq. in. = $192\frac{2}{3}$ sq. ft.

(3.) $1\frac{61}{64}$ cu. ft; $2\frac{19}{27}$ cu. ft.; $14\frac{197}{1728}$ cu. ft.
(5.) 144 + 13.856 = 157.856 sq. ft.; 198 + 26.196 = 224.196 sq. ft. (6.) 210 + $24\frac{1}{2}$ = $234\frac{1}{2}$ sq. ft.
(7.) $1\frac{8}{16}$ sq. ft.; 5 sq. ft. 71.6832 sq. in.
(8.) 314.16 + 25.1328 = 339.2928 sq. ft.
(9.) $64\frac{1}{2}$ sq. ft. outside surface; 58 sq. ft. inside.

(10.) 83.136 cu. ft. = 83 cu. ft. 235 cu. in.; 157.176 cu. ft.
(11.) $183\frac{3}{4}$ cu. ft. (12.) 424.116 cu. in.; 1.37445 cu. ft.
(13.) 3078.768 cu. in. = 1 cu. ft. 1350.768 cu. in.
(14.) 190.0668 cu. ft. (15.) 1425.48 gal.

(16.) $187\frac{1}{2}$ sq. ft.; 120 sq. in. (17.) 150 sq. in.
(18.) £14 0s. 8.96d. (19.) 2744 cu. in.; $7\frac{7}{27}$ cu. ft.
(20.) 21.3803 cu. ft. (21.) 28.9352 cu. ft.

(22.) 110 + $11\frac{1}{9}$ + $4\frac{2}{3}\frac{1}{8}$ = 125 sq. ft. 116 sq. in.
(23.) Curve surface 11196.66 sq. in. + the ends 1452.2 and 415.48 sq. in. = 90.7246 sq. ft. (24.) $\$20.62\frac{1}{2}$.

(25.) 81.972 cu. ft. (26.) 42.07 cu. ft. (27.) 23680 lb.
(29.) 2.3148 cu. ft.

(30.) 706.86 sq. ft. (31.) 201,062,400 sq. miles.

(32.)* 8,132,726.61 sq. miles the surface of each frigid zone; 51,041,552.9 sq. miles the surface of each temperate zone; 78,314,113.089 sq. miles the surface of the torrid zone.

(33.) 2144.6656 cu. in. (34.) 5,424,617,475.2 cubic miles.

(35.) 2.4179 ft. (36.) 2 ft. 7.474 in.
(37.) 8 ft. 9 in. nearly. (38.) 14.707 inches.
(39.) 17.307. (40.) 21.80544. (41.) 10 ft. 9.074 in.

* The circumference of a circle is nearly 3.141592653589793 times its diameter. The pupil may use this number in performing No. 32.

(42.) 1 cu. in. (43.) 8 cu. in.; 8 times.
(44.) 27 cu. in; 27 times.
(45.) 60 cu. ft.; 480 cu. ft.; 1620 cu. ft.; $7\frac{1}{2}$ cu. ft.
(48.) 6 inches. (49.) 15875.15625 gal. (50.) $10\frac{1}{8}$ cords.
(51.) 800.6 lb.; 8.013 ft. (52.) 2.4756 ft.
(53.) 11.9055 ft.; 10.40018 ft.; 13.1032 ft. (54.) $\frac{8}{27}$.
(55.) $7\frac{13}{16}$ tons. (56.) $13\frac{1}{2}$ lb. (57.) $568\frac{137}{216}$ lb.
(58.) 27.5181 oz.; 220.1448 oz.; 742.9887 oz.; 1761.1584 oz.; 5943.9096 oz. (59.) .4923 of a foot = 5.90844 inches.

180. $32\frac{7}{12}$ sq. ft.; $28\frac{8}{36} = 28\frac{2}{9}$ sq. ft.; $24\frac{7}{16}$ sq. ft.; $40\frac{35}{48} = 40\frac{3}{4}$ sq. ft.

193. (2.) 4676 bricks. (3.) $145\frac{1}{8}$ cu. ft.
(4.) $793\frac{3}{4}$ cu. ft. (5.) 20547 bricks.
(6.) Length 14.912 ft. = 14 ft. 11 in., width 11.184 ft. = 11 ft. 2 in., and the height 7.456 ft. = 7 ft. $5\frac{1}{2}$ in.
(7.) 589.4 sq. ft.; $10.61.

195. (3.) $181\frac{8}{11}$ lb.; 3575 lb.
(4.) $\frac{8}{15}$ of 1 foot from the weight, or $15\frac{5}{15}$ ft. from the power.
(5.) $\frac{3}{16}$ of 1 foot from the weight, or $3\frac{3}{19}$ ft. from the power.
(6.) $3\frac{3}{7}$ ft. from one end.
(7.) 100 lb.; 400 lb.; 250 lb.; 175 lb.
(8.) 60 lb.; $\frac{8}{10}$ of 1 foot from the fulcrum.
(9.) 200 lb.; $3\frac{1}{3}$ ft. from the fulcrum.

196. (1.) 20 lb. (2.) $1898\frac{2}{11}$ lb. (3.) $3\frac{3}{5}$ in. (4.) 10 lb.

197. (1.) 2560 lb.; 40 lb. (2.) 90 lb.; 250 lb.

198. (1.) 50 lb.; 49 lb. nearly. (2.) 80 lb.

200. (1.) 9.948 lb.; 6031.872 lb.
(2.) .565 of an inch; 5.3 ft. (3.) 45,240 lb.
(4.) 169,646$\frac{1}{4}$ lb. (5.) 1,357,170 lb.; 1,107,918.

201. (17.) 627 sq. ft.; $69\frac{2}{3}$ sq. yd.
(18.) $20\frac{3}{4}$ sq. ft.; $\$10\frac{3}{8} = \$10.37\frac{1}{2}$; $\$5\frac{3}{16} = \$5.18\frac{3}{4}$; $\$6\frac{1}{12} = \$6.91\frac{2}{3}$. (19.) 10 ft. long; 2 ft. deep; 3 ft. deep.
(20.) $150. (21.) 20 ft.
(22.) 30 rods; diag. 50 rods; $175.
(23.) 200 and 162 ft.; 300 and 243 ft.; 500 and 405 ft.; 25 and $20\frac{1}{4}$ ft. (24.) 50 and $40\frac{1}{2}$ ft.; 200 and 162 ft.

(25.) $\frac{1}{8}$ as many; $\frac{1}{125}$ as many.
(26.) $12\frac{1}{2}$ cu. ft.; $337\frac{1}{2}$ cu. ft.; $\frac{8}{27}$ of the whole.
(27.) $\frac{1}{10}$ of 1 day. (28.) $9\frac{3}{10}$ da. (29.) $400.
(30.) A's share $72.40, B's $162.90, and C's $126.70.
(31.) 80 cts. per bushel. (32.) A's age 25 years; B's 30.
(33.) John's age 12 years; William's 16 years.
(34.) 9 ft. from the 10 lb. weight.
(35.) $6\frac{1}{4}$ ft. from one end. (36.) 200 lb.

SECTION XXII.

202. (1.) 600,050,034; 315,003; 90,000,090,090; 307,006,000,050; 75,004,000,000,400; 800,000,075,000,001.
(2.) 875,401,681,455,578.
(3.) 23,875,004; 307,008,021,070; 5,003,074; 97,000,008,001; 16,000,105,000,400; 875,015,000,025,000.
(4.) 891,419,141,932,549.
(5.) .45; 30.06; 1000.073; 7816.5101; 418.005075; 10.00015.
(6.) .0354; .084015; 25.0334; 57.025; 300,000.00809.
(7.) 9275.098325; 300,082.185905.
(8.) 30,186.050,164; 8,001.0040,008; 90,006.000,800,004; 890106.00,050,087; 51,008,009.0008,070,108.
(9.) 52,026,308.0562,726,848.
(10.) Sum 47,030.14707; difference 41,009.95307; product 132,504,620.65,555,679.
(11.) Sum $222\frac{7}{24}$; difference $191\frac{11}{12}$; product $3145\frac{19}{256}$.
(12.) 28,304,150.9,434. (13.) $71\frac{33}{81}\frac{5}{2}$; $1\frac{3}{3}\frac{2}{1}\frac{3}{8}\frac{7}{1}$.
(14.) 539 m. 3 fur. 28 rd. 3 yd. 2 ft.; 101 A. 1 R. 30 sq. rd. 6 sq. yd. 7 sq. ft. 72 sq. in.; 3354 cu. yd. 936 cu. in.
(15.) £503 8s. 9d. (16.) £239 6s. $10\frac{1}{2}$d.
(17.) 11 A. 3 R. 2 sq. rd. 26 sq. yd. 1 sq. ft. 138 sq. in.;
47 A. 11 sq. rd. 14 sq. yd. 1 sq. ft. 12 sq. in.;
70 A. 2 R. 17 sq. rd. 6 sq. yd. 72 sq. in.;
188 A. 1 R. 5 sq. rd. 26 sq. yd. 2 sq. ft. 12 sq. in.
(18.) 1 A. 19 sq. rd. 3 sq. yd. 7 sq. ft. $77\frac{3}{5}$ sq. in.;
2 R. 9 sq. rd. 17 sq. yd. 0 sq. ft. $56\frac{4}{5}$ sq. in.;
1 R. 19 sq. rd. 21 sq. yd. 4 sq. ft. $1\frac{1}{5}\frac{2}{5}$ sq. in.;
35 sq. rd. 24 sq. yd. 8 sq. ft. $101\frac{3}{2}\frac{3}{5}$ sq. in.
(19.) 1440; 1575. (20.) 4. (21.) 20. (22.) $131\frac{1}{9}$.
(23.) $21\frac{1}{8}\frac{2}{8}$; $42\frac{1}{2}\frac{9}{7}\frac{1}{6}$. (24.) 8s. 11d. $0\frac{5}{6}\frac{1}{4}\frac{1}{3}\frac{3}{6}$qr.
(25.) 2 fur. 6 rd. 5 yd. 0 ft. $0\frac{9}{1\,4}$ in.

(26.) £$\frac{3}{7}$ = 8s. 6d. $3\frac{3}{7}$qr.; £.45 = 9s.; .3s. = 3d. 2.4qr.; $\frac{4}{5}$s. = 5d. $1\frac{1}{3}$qr.; $\frac{5}{14}$ da. = 8 h. 34 min. $17\frac{1}{7}$ sec.; $\frac{15}{22}$ gal. = 2 qt. 1 pt. $1\frac{9}{11}$ gill. (27.) $25\frac{45}{112}$ and $129\frac{3}{112}$. (28.) $5,644.

(29.) $24.34. (30.) $848.58.

(31.) Legal rule, $23.03; common rule, $19.49; compound, $22.87. (32.) 1900 sq. ft. (33.) 33.54 ft.

(34.) 314.16 sq. ft.; 523.6 cu. ft. (35.) 35 min. $21\frac{3}{7}$ sec.

(36.) Whole area, 9493.875 sq. ft.; area of the pond, 176.715 sq. ft.; exclusive of the pond, 9317.16 sq. ft.

(37.) 201.0624 cu. ft.; 188.496 sq. ft., surface.

(38.) 203.4186 sq. ft. (39.) 79.7305 ft.

(40.) 68,931 bricks, if the wall is to stand *without* the given dimensions; 67,635 bricks, if the wall is to stand *within*.

(41.) $278\frac{1}{3}$ cu. ft., if the wall stands *on* the area of the garden; $283\frac{2}{3}$ cu. ft., if it stands *without* the area of the garden.

(42.) $2,534,400. (43.) Gain $8.05 = $8\frac{805}{1000}$ per cent.

(44.) $10,050. (45.) 5 per cent. (46.) $2\frac{671}{4338}$.

(47.) $6.90 per bbl. (48.) $223\frac{1}{18}$ sq. ft.; $5.59; $68\frac{26}{27}$ cu. ft.

(49.) $16.94. (50.) 15°; 4 min.; $\frac{1}{4}$ deg.

(51.) At 45° E., 3 o'clock P. M.; at 45° W., 9 o'clock A. M.; at 50° E., 3 h. 20 min. P. M.; at 55° W., 8 h. 20 min. A M.; at London, 4 h. 43 min. 36 sec. P. M.

(52.) At London, 1 h. 44 min. 16 sec. P. M.; at New Orleans, 7 h. 44 min. 16 sec. A. M.; at San Francisco, 5 h. 35 min. 20 sec. A. M.; at Constantinople, 3 h. 40 min. 12 sec. P. M.

(53.) From the west; 5°. (54.) Long. 48° 45′ W.

(55.) 24,899.21 miles; 1,037.467 miles per hour.

(56.) Surface, 2025 to 16, or $126\frac{9}{16}$ to 1; contents, 91125 to 64, or $1423\frac{23}{64}$ to 1. (57.) $12\frac{1}{2}$ lb.; 800 lb.; 12 in.

(58.) 1.929 ft. deep. (59.) $17\frac{143}{225}$; $19.84; $11.95.

(60.) $70,498\frac{1}{2}$ bricks. (61.) $5517.84. (62.) $135.80.

(63.) 9 ft. 2.7 in.

(64.) Due Aug, 1, 1849, 198 days from Jan. 15; April 1 1849, $4707.67; Jan. 1, 1850, $5072.92.

(65.) 2150.4 cu. in.; 12.9074 in. (66.) $2\frac{26}{47}$ da.

(67.) 20 da.; 300 miles.

(68.) $33\frac{1}{3}$ da.; A 400, B 500, C 600 miles.

(69.) A 356\frac{2}{3}$; B 236\frac{2}{3}$; C 406$\frac{2}{3}$.

(70.) A 261\frac{2}{3}$; B 336\frac{2}{3}$; C 401\frac{2}{3}$.

(71.) 12 da. 5 h. 20 min.; 13 yr. 89 da. 17 h. 6 min. 40 sec.; 515 yr. 322 da. 4 h. 13 min. 20 sec.

KEY

TO THE

AMERICAN

COMMON-SCHOOL ARITHMETIC;

WITH

AN APPENDIX.

BY RUFUS PUTNAM,
PRINCIPAL OF THE BOWDITCH (ENGLISH HIGH) SCHOOL, SALEM, MASS

BOSTON.
TAPPAN, WHITTEMORE & MASON,
114 WASHINGTON STREET.
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APPENDIX.

THE design of the following pages is, 1. To furnish the teacher with such help as may enable him to detect any error in the work of his pupils, with as little labor as possible; 2. To give such additional explanations, and make such suggestions, as may be thought proper, in reference to the topics under consideration; and, 3. To give additional questions, involving the same principles as those in the text-book, which the teacher may dictate to his pupils at each recitation, and thus more certainly test their knowledge of the subject.

The author has found, and probably every other teacher has found, that for his pupils to get correct answers to the questions in their lessons in Arithmetic is one thing; another thing, to have the work correctly performed; another still, to be able to explain and give reasons for each step in the operation; and yet quite another thing, to perform at the moment, and correctly, other questions involving the same principles as those in the lesson. But if he cannot do the last, his having done the other can prove of little practical advantage.

The teacher will observe that articles marked a contain solutions of the questions in the text-book, so far as they seemed necessary for his use; while those marked b contain questions similar to those in the Arithmetic with their answers, and which, by reference to the Arithmetic, can easily be dictated to the class at recitation.

The author cannot but hope that these questions will be peculiarly acceptable to the teachers who may use his book, as he is assured that such an exercise will be of great benefit to the pupil.

The author would make a single remark in reference to recitations conducted by question and answer. It is this. Every answer of the pupil should contain a distinct and entire proposition. A few examples will illustrate this. *Teacher.* "How many are 8 times $7\frac{1}{5}$?" *Pupil.* "Eight times $7\frac{1}{5}$ are $62\frac{2}{5}$;" and not "$62\frac{2}{5}$" alone. *Teacher.* "What is the rule for reducing compound fractions to simple ones?" *Pupil.* "To reduce compound fractions to simple ones,

reduce all the numbers to a fractional form; and after cancelling," &c. This method of answering questions has the sanction of antiquity, as well as of common sense. Thus, the Catechism of the Westminster Assembly. *Ques.* "What is the chief end of man?" *Ans.* "Man's chief end is to glorify God, and enjoy him forever."

It is believed that most of the pupils of twelve, and even of fifteen years of age, in our schools, have not acquired one half the facility in performing the operations of Addition, Subtraction, Multiplication and Division, that children several years younger might acquire, by proper drilling in these elementary operations.

If this is true, it follows that one half of the time devoted to arithmetical operations at school, to say nothing of subsequent years, is wasted, nay, worse than wasted; for the value of an education is not to be estimated by the time spent in acquiring it, nor by the amount of knowledge acquired, but rather by the *habits* formed while at school. We will suppose, for example, that two young men have completed their school education, and that one of them, in consequence of more skilful training, can perform the fundamental operations in Arithmetic twice as rapidly as the other, and, at the same time, is less liable to error than the other. The advantage which the former possesses over the latter will not appear in such operations only, or chiefly, but in the habit of fixing the attention closely, of rapid and correct execution, not in Arithmetic alone, but in everything to which his attention is called. A mind thus educated will accomplish more in ten years, other things being equal, than the other in fifteen. While the one is ever awake to seize opportunities for action as they present themselves, the other is ever vainly stretching out the hand towards the bird that has flown beyond his reach.

It is hoped that the following suggestions may be useful in calling the teacher's attention to this subject, and in leading him to adopt such a system of teaching, that his pupils may learn to do with their might whatever either their heads or their hands have to do.

ADDITION.

Let the teacher write upon the black-board Exercise No. 1 in addition; and standing near it, let him with his pointer call the attention of the pupil to the numbers, in rapid succession, first from the bottom to the top, and then from the top to the bottom, while the pupil says aloud, one, two, three, four, five, &c. The teacher should continue the exercise till the pupil, in speaking, keeps exact time with the motion of the pointer. Let him do the same with Nos. 2 and 3, adding first upwards, then downwards. Nos. 4 and 5 are a little more difficult; but let each exercise be continued till the scholar can add the column nearly as rapidly as he can pronounce the numbers distinctly, using longer columns if thought desirable.

The teacher may then give the exercises 6 to 12 to the class, for a

lesson to be studied at their seats for the next recitation. On no account should the larger numbers be introduced, till the scholar can add all the possible combinations of the smaller ones almost with the rapidity of thought.

The degree of proficiency to be aimed at in all these elementary operations should be similar to what is aimed at in learning to read. Take, for example, the sentence, "*Let me read in this book.*" The beginner repeats slowly, "L-e-t let, m-e me, r-e-a-d read, i-n in, t-h-i-s this, b-doubleo-k book. By degrees he is able to go through the sentence more rapidly; thus, Let-me-read-in-this-book. But even *this* is not reading: the pupil must be able to pronounce correctly every word that occurs, the instant it meets his eye; and he is not a fluent reader till he can do this. So, in adding the numbers in exercise 22, for example, he should be able to pronounce the numbers four, seven, nine, thirteen, sixteen, eighteen, twenty-two, twenty-five, &c.; or downwards, four, six, nine, thirteen, fifteen, &c., as rapidly, and with as much ease, as if they were written down in words; not adding them by saying "Four and three are seven, and two are nine," &c. And, as in reading, so in Arithmetic, he should not attempt more difficult combinations till he is fully master of the easier ones. A few days spent in this way will satisfy the teacher that a much higher degree of proficiency may be made by very young pupils than he had supposed to be possible, if his attention has not been previously called to this subject.

The few examples given below will be sufficient to indicate the methods the author would recommend. The teacher will observe that, in using the higher numbers, the number of different combinations will rapidly increase.

EXERCISES IN ADDITION.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1	2	1	1	1	3	1	3	3	1	1	2	3	4	1	3	4	4
1	2	2	2	2	3	3	1	2	3	2	3	0	4	4	4	1	2
1	2	2	1	2	3	3	3	3	2	3	2	3	4	4	4	4	4
1	2	2	2	2	3	3	1	2	1	1	2	2	4	4	4	1	2
1	2	2	1	1	3	3	3	3	3	2	1	1	4	4	4	4	4
1	2	2	2	1	3	3	1	2	2	3	1	0	4	4	4	1	2
1	2	2	1	1	3	3	3	3	1	1	1	1	4	4	4	4	4
1	2	2	2	2	3	3	1	2	3	2	3	2	4	4	4	1	2
1	2	2	1	1	3	3	3	3	2	3	1	3	4	4	4	4	4
1	2	2	2	2	3	3	1	2	1	1	2	0	4	4	4	1	2
1	2	2	1	2	3	3	3	3	3	2	1	3	4	4	4	4	4
1	2	2	2	1	3	3	1	2	2	3	2	2	4	4	4	1	2
1	2	2	1	1	3	3	3	3	1	1	3	3	4	4	4	4	4
1	2	2	2	2	3	3	1	2	3	2	2	1	4	4	4	1	2
1	2	2	1	2	3	3	3	3	2	3	3	2	4	4	2	4	4
1	2	1	2	1	3	2	1	2	1	1	1	1	4	2	4	1	2

(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
4	4	4	4	4	3	5	2	4	5	2	3	5	5	1	2	1	1
3	2	3	2	1	0	5	5	5	1	5	5	4	1	3	3	4	2
4	1	1	3	3	2	5	5	5	5	2	3	5	2	5	5	5	4
2	4	4	4	2	2	5	5	5	1	5	5	4	5	1	2	1	3
4	2	3	2	4	1	5	5	5	5	2	3	5	1	3	3	4	5
3	1	1	3	1	3	5	5	5	1	5	5	4	2	5	5	5	1
4	4	4	4	3	3	5	5	5	5	2	3	5	5	3	2	1	2
3	2	3	2	2	4	5	5	5	1	5	5	4	1	1	3	4	4
4	1	1	3	4	0	5	5	5	5	2	3	5	2	5	5	5	3
3	4	4	4	1	4	5	5	5	1	5	5	4	5	1	2	1	5
4	2	3	2	3	3	5	5	5	5	2	3	5	1	3	3	4	1
3	1	1	3	2	3	5	5	5	1	5	5	4	2	5	5	5	2
4	4	4	4	4	2	5	5	5	5	2	3	5	5	1	2	1	4
3	2	3	2	1	1	5	5	5	1	5	5	4	1	3	3	4	3
4	1	1	3	3	4	5	5	5	5	2	3	5	2	5	5	5	5
3	4	3	4	2	3	5	1	3	1	5	5	4	5	1	2	1	2

SUBTRACTION.

5123456789135790246895318642697540875986718497167516
1023102767023480121454915331363220330342412262145305

The method of performing subtraction, where the figure of the subtrahend is larger than the corresponding figure of the minuend, may be explained either by the axiom, that if the same quantity be added to two unequal quantities, their difference remains the same as before; or it may be explained by the more modern method of borrowing 10 from the next left hand figure in the minuend. The latter method has at least one advantage over the former. It depends entirely upon principles of the decimal notation already recognized and understood; and tends moreover to render these principles still more familiar to the learner; whereas the former depends upon an axiom, the truth of which is not very easily apprehended by a child's mind, and the application of which, in this case, must appear to him entirely arbitrary, if indeed it is not really so.

The pupil should be thoroughly drilled in subtraction. The proficiency aimed at should be, an ability to perform the operation and the proof of it correctly, and as rapidly as he can write the figures.

Note. While adding the remainder and subtrahend to prove the operation, the pupil should cover the minuend from sight.

805763500074681984760087005168480814225
314787801553468339701900983750909078 82

490975699919335150789896906793389906343

805763500074681984760087005168480814225

MULTIPLICATION.

The same rapidity of operation should be aimed at in multiplication as in addition and subtraction. Dictate to the class some such multiplicand as the following: 879640078145321560849730104538762704. Having explained to them, if necessary, the operation of multiplying by two, let them take it to their seats and practise upon it till they can multiply as rapidly as they can write the figures. Then, at recitation, the order of the figures being changed, let one of the class stand at the board, and write the figures of the answer as they are dictated by another. They will be ambitious to dictate them faster than their fellows can write them. Proceed in the same manner with 3 as a multiplier, and with each of the remaining figures, not forgetting to review, at each recitation, the preceding lessons. At such recitations the pupils should be called upon promiscuously to take up and continue the work at any time the teacher may choose. This will secure the attention of the whole class.

DIVISION.

Pursue the same course with division as was taken with multiplication; letting the pupil become very familiar with short division before he attempts long division.

NOTE. Exercises like the above in the elementary operations of written arithmetic should not be deferred till the pupil has commenced what is commonly understood by "written arithmetic." They should form a prominent part in the drill of the primary school. The child, for example, who can count fifty, should be exercised in adding such columns as those in addition. The child that can say two times 1 are 2, two times 2 are 4, two times 3 are 6, &c., can very easily be taught to multiply by 2 as suggested in multiplication. Such an exercise will be a very important auxiliary in learning the Multiplication Table.

The following pairs of factors have the same product, viz., 403291-46112660563558400. They will furnish exercises both in multiplication and division.

8065829222532112711680	× 5	840490544013761740800	× 48
5041143264082570444800	× 8	77556050216654929920 0	× 52
3666286010241869414400	× 11	707528879169483571200	× 57
2880658293761468825600	× 14	640145176391437516800	× 63
2372302712509444915200	× 17	537721948166807514112	× 75
1920435529174312550400	× 21	530646659377112678400	× 76
1493672078246687539200	× 27	474460542501888983040	× 85
1260285816020642611200	× 32	420245272006880870400	× 96
1152261317504587530240	× 35	230452263500917506048	× 175
1061293318754225356800	× 38	117921479861580595200	× 342
960217764587156275200	× 42	294803699965395148800	× 1368
916571502560467353600	× 44	561530856483717120 0	× 7182

18b. (11.) . . . "in 1830," except Vermont?
Ans. 1,674,55
" " except Mass. and N. Hampsh
Ans. 1,075,47
" " except Maine?
Ans. 1,555,25

Ask the same questions for 1840.
Answers. 1,942,874; 1,212,549; 1,733,02

(13.) . . . "in 1830," except Maryland and Virginia?
Ans. 2,572,44
" " " North and South Carol
and Georgia? Ans. 2,394,89
. . . "in 1830," except Louisiana and Florida?
Ans. 3,980,42

Ask the same questions for 1840.
Answers. 3,456,216; 3,126,823; 4,759,14

(14.) . . . "in 1830," except Ohio? Ans. 2,072,77
" " " Michigan and Arkansas?
Ans. 2,948,65
" " " Tennessee and Kentucky
Ans. 1,640,86

The same for 1840.
Answers. 3,538,687; 4,748,313; 3,449,11

(15.) . . . "in 1830," except N. York, Mass., and Virgi
Ans. 9,120,77
" " " Conn., Penn., and Missou
Ans. 11,074,83
" " " Rhode Island, Alabama
Indiana? Ans. 12,111,43

The same for 1840.
Answers. 12,556,936; 14,645,640; 15,677,90

(19.) . . . "to A" $5,016.45, to B $500.91; to C $5
and to E $1,010.01 . . .? Ans. $6,532.4

(20.) Add $5.187, $74.01, $840.351, $6010.804, $3001.
$4108.011, and $5917.94. Ans. $19,957.31

(21.) Add 48.001, 307.1184, 140.0307, 576.004, 1,009.
and 807.0805. Ans. 2887.243

(22.) Add 20,507, 806,004, 51,000,807, 909,090,
80,416,087, and 4,008,007,001. Ans. 5,049,341,31

(23.) Add 50.064, 8,008.0057, 7,864.90,018, 5,060,
0,908, 5,006,007.31,008, 2,516.8,107, and 351,080.101,80
Ans. 10,436,235.283,26

(25.) . . . 4.25 bu. for $3.25; 6.5 bu. for $4.625; 9.75 bu. for $7.375; 2 bu. for $1.48, and 3.25 bu. for $2.25.

Ans. 25.75 bushels for $18.98.

(26.) Beginners will do this and the following by addition. To get the number of days in 8 years, they should write down 365.25 eight times and add it, and prove the result by adding the number of days in 4 years twice. The other answers should be proved in a similar way.

The number of days in 5 years is 1826.25; — in 7 years, 2556.75; — in 12 years, 4383; — in 18 years, 6574.5 days.

(27.) . . . 3 bbls. at $6.375; 4, at $5.875; 3, at $6.08; 5, at $6.15; 7, at $4.81; and 6, at $5.35, . . . ?

Ans. $157.385.

21b. (20.) $4,501.034 — $1,008.073 = $3,492.961. $1000 — $70.91 = $929.09.

(21.) 30,407.001 — 10,649.0108 = 19,757.9902. 40,164 — 357.08,079 = 39,806.91,921.

(22.) In 1830, how many more in the Middle than in the New England states? Ans. 2,709,205.

. . . How many more in the Southern than in the Middle?

Ans. 566,479.

. . . in the Southern than in the Western?

Ans. 1,220,209.

The same questions for 1840.

Ans. 2,369,523; 561,687; 107,878.

(23.) . . . 5,001,008,070 than 80,908,079?

Ans. 4,920,099,991.

(24.) . . . to 13,010,807 to make 85,008,007,001?

Ans. 84,994,996,194.

(25.) . . . 8,045,016 and 301,864,008?

Ans. 293,818,992.

(26.) 4,018.3,017 — 109.00,807? Rem. 3,909.29,363.

(28.) . . . for $23.87 . . . two barrels of flour at $5.875, . . . ?

Ans. Money, $12.12.

23b. (1.) . . . 5 bu. at 87 cts. . . . 6 gallons at $.285?

Ans. $2.64.

(2.) . . . 4 pairs at $1.125 . . . 5 bu. at 75 cts.?

Ans. The farmer pays 75 cts.

(3.) . . . coat $12.25, vest $3.125, pants $6.375 . . . 3 ten dollar bills? Ans. $8.25.

(4.) . . . owed $1000.50 . . . one debt $74.27, $125.74; $40.50, $64.23? Ans. $695.76.

(6.) . . . A $540.29; B $327.875; C $805.35? Ans $1673.515 in all. $212.415 more to A than B; $477.475 more to C than B; $265.06 more to C than A.

(8.) . . . 80,701,094 + 189,076,040 to make 4,080,190,080? Ans. 3,810,412,946.

(9.) . . . $1,016.75 . . . $145.25? Ans. After the 1st payment, $871.50; . . . 2d, $726.25; . . . 3d, $581; 7 payments in all.

27b. (4.) $842 \times 8 = 6,736$; $78,418 \times 5 = 392,090$; $30,100,875 \times 9 = 27,097,875$.

(6.) $48.3 \times 6 = 289.8$; $7504.5 \times 7 = 52,531.5$.

(7.) $510,870.854 \times 4 = 2,043,483.416$; $6,070.9104 \times 6 = 36,425.4624$.

(8.) 7 barrels at 6.625? Ans. $46.375.

(10.) 6 bbls. at $2.25, and 7 bu. at $.875? Ans. $19.625.

(11.) $4.097 \times .4 = 1638.8$; $81,758 \times .06 = 4,905.48$; $4,918,006 \times .008 = 39,344.048$.

(12.) $80.417 \times .5 = 40.2085$; $30.7108 \times .007 = .2,149,756$.

(14.) $9,056.1008 \times .00009 = .815,049,072$; $70.16,049 \times .00004 = .0028,064,196$.

28b. (8, 9, &c.) 4875×100; $374,100 \times 1000$; 804.016×10; 804.016×100; $.304,108 \times 1000$. The teacher can add other examples at pleasure.

(14.) $305,167 \times 80,000 = 24,413,360.000$; $41,083 \times 900 = 36,974,700$.

(17.) $516.18 \times 4,000 = 2,064,720$; $6.015 \times 60,000 = 360,900$.

(18.) $815,000 \times 7 = 5,705,000$; $608,070,000 \times 5 = 3,040,350,000$.

(19, &c.) $5,108,000 \times 9,000 = 45,972,000,000$; $397,010,000 \times 50,000 = 19,850,500,000,000$.

NOTE.—Pupils should be drilled in the principles thus far introduced in multiplication, until they can apply them readily and correctly, before attempting to multiply by numbers consisting of several significant figures.

The methods of proving multiplication by division, and also by "casting out the 9's," though not alluded to in the text, may be easily explained to the pupil at such a period of his progress as the teacher may prefer. The proof by division, viz., *Divide the product by the multiplicand; the quotient will equal the multiplier; — or, divide the product by the multiplier; the quotient will equal the multiplicand, if the work is right*, may be taught him as soon as he has learned division.

The proof "by casting out the 9's" depends upon a property that is peculiar to the numbers 3 and 9, viz., that any number divided by 3 or 9 will leave the same remainder as the *sum* of its figures divided by 3 or 9. Thus the number 87145 divided by 3 leaves a remainder of 1, and divided by 9 leaves a remainder of 7. So the *sum* of its figures, 25, divided by 3 and by 9, leaves the same remainders.

The rule for proving multiplication by this method may be thus stated. Divide the sum of the figures in the *multiplicand* by 9, and write the remainder to the right of the multiplicand. Divide the sum of the figures in the *multiplier* by 9, and write the remainder to the right of the multiplier. Multiply these remainders together, divide the product by 9, and note the remainder. Then divide the sum of the figures in the *product* by 9, and if the remainder is not equal to the remainder last noted, the work is certainly wrong; if the remainders are equal, the work may be *supposed* to be right. If, however, any figure in the product should happen to be as much too large as another is too small, or if a 9 be written for an 0, or the reverse, this method of proof will not detect the error.

54,016 . . . 7 rem.
476 . . . 8 rem.

324096 56 . . 2 rem.
378112
216064

25,711,616 . . . 2 rem.

29b. (6.) 193,051 × 35 = 6,756,785; 17,166 × 46 = 789,636; 153,227 × 52 = 7,967,804; 8650 × 135 = 1,167,750; 226,447 × 387 = 87,634,989; 31,235,678 × 10,203 = 318,697,622,634.

(7.) 41.008 × 27 = 1,107.216; 301.09 × 15.07 = 4,537.4,263.

6.1001 × .061 = .3,721,061; 304,070,000 × .0407 = 12,375,649.

4,010,900,000 × 3.081 = 12,357,562,900;
$30.04 × 18,000 = $540,720;
.0180,701 × .00416 = .000,075,171,616.

31a. (7.) Wheat, $71.25. Molasses, $21.00; sugar, $4.80; grass-seed, $6.375: fish, $4.50; broadcloth, $16.25.
Ans. $71.25 — $54.425 = $16.825.

(41.) Potatoes, $3.60; squashes, $1.125; apples, $.68; turnips, $1.50; milk, $1.80; eggs, $.465; onions, $.50.
Ans. $9.67.

(42.) Molasses, $.72; sugar, $1.05; coffee, $2.20; fish, $.20; rice, $1.37½; boots, $3.25. Ans. $9.67 — $8.795 = $.875.

(43.) Molasses, $134.32; butter, $65.70: cheese. $8.625.
Ans. $134.32 — $74.325 = $59.995.

(45.) Potatoes, $109.375; apples, $53.125: squashes, $3.50. Cow, $40.75; flour, 20.25. Ans. $166 — $61 = $105.

(50.) . . . = 264,716,870,000,000 + 2,504,000 ÷ 34,967,829 = 264,716,837,536,171.

(51.) . . . = .261,490,977 + 15.0084 — 3.6,810,084 = 11.588,682,577.

(52.) . . = 4,436.97,459 × 510,875,000 = 2,266,739,393,666.25; and this product — 857,601.007 = 2,266,738,536,065.243.

(53.) First product, 6,090,364,388,240; rem. 6,090,359,347,439.2949. Second product, 1,683,938,558,432. Sum, see key.

(54.) Tea, $6.75; chocolate, $2.45; coffee, $.96; sugar, $1.43; flour, $7.12. Ans. $18.71.

(56.) Potatoes, $56.25; turnips, $2,50; beets, $.90; onions, $1.80; cabbages, $1.50; squashes, $3.00. Ans. $65.95.

31b. (2, 3 and 4.) . . . 23 rows, . . . 19 trees. Ans. 437 trees; 1311 barrels; $2130.375; net value, $1907.505.

(5 and 6.) . . . 15 acres at $32.65; 48.25 cords per acre.
Ans. $489.75; 723.75 cords; $1031.34375.

(7.) . . . 115 bu. at $1.05 = $120.75; 84 gal. at 24 cts. = $20.16; 67 lbs. at 8 cts. 5 mills = $5.695; 3 bu. at $1.875 = $5.625; 175 lbs. at 5 cts. = $8.75; 8 yards at $4.35 = $34.80 $120.75 — $75.03 = $45.72.

(8.) £45 15s. = 915s.; £143 19s. = 2879s.

(9.) £25 18s. 11d. = 6227d.; £119 19s. 11d. = 28800d.

(10.) £56 14s. 8d. 3qr.; = 54,467qr.; £108 18s. 0d. 3qr. = 104,547qr.

(11.) 45 bbls. at £1 3s. 5d. = 281d. × 45 = 12,645d.

(12.) 15 yr. and 218 da. = 5696.75 da.; 205 yr. 25 da = 74,901.25 da.

(13.) 3 yr. 117 da. 21 h. = 29,127 h.

(14.) 250 da. 17 h. 29 min. = 361,049 min.; 5 w. 6 da. 13 h. 47 m. = 59,867 min.

(15.) 21 h. 25 m. 18 sec. = 77,118 sec.; 2 yr. 224 da. 17 h. 25 m. 13 s. = 82,531,513 sec.; 7 yr. 348 da. 21 h. 48 sec. = 251,046,048 sec.

(16.) 23 lb. Troy = 276 oz. = 5520 dwt. = 132,480 gr.

(18.) 15 lb. 10 oz. 19 dwt. 21 gr. = 91,677 gr.; 21 lb. 15 dwt. 8 gr. = 121,328 gr.

(19.) 8 lb. 10 oz. 18 dwt., at $.055 per dwt., = 2138 × .055 = $117.59.

(20.) 1368 gal. = 5,472 qt. = 10,944 pt. = 43,776 gi.

(22.) 165 gal. 3 qt. 1 pt. = 1327 pt.

(23.) 308 gal. 3 qt., at 6 cts. 5 mills, = 1235 × .065 = $80.275.

(25.) 8 bu. 2 pk. 7 qt. = 558 pt.

(26.) 4 bu. 3 pk. 6 qt., at 7 cts. 5 m., = 158 × .075 = $11.85.

(29.) 25 m. 7 fur. 35 rd. = 8,315 rd.

(30.) 5 m. 3 fur. 27 rd. 3 yd. = 9,611.5 yd.; 6 m. 5 fur. 37 rd. 5 yd. = 11,868.5 yd.

(31.) 5 m. 6 fur. 15 ft. 3 in. = 364,503 in.; 10 m. 25 rd. 13 ft. 3 in. = 638,709 in.

(34.) the rails for 9 miles at 4½ cts. per lb. = 95,040 ft. × 18 × .045 = $76,982.40.

(35.) 13 A. 3 R. 27 sq. rd. = 2227 sq. rd.

(36.) 32 sq. rd. 17 sq. yd. = 985 sq. yd. = 8965 sq. ft.

(37.) 24 sq. rd. 18 sq. yd. 8 sq. ft. 175 sq. in. = 965,551 sq. in.

(38.) 3 A. 15 sq. rd. 20 sq. yd., at $.125 per sq. ft., = 134,943.75 × .125 = $16,867.96,875.

(39.) 5 cwt. 2 qr. 17 lb. 5 oz. = 10,133 oz.

(40.) 3875 lb. at $.105 per lb. = $406.875.

(41.) 6 bu. potatoes at 23 cts. per pk. = $5.52; 63 lb. at $.025 = $1.575; 5 bu. turnips at $.15 per pk. = $3.00; 10 gal. milk at $.035 per qt. = $1.40; 5 doz. eggs at $.175 = $.875; 17 bunches onions at $.025 = $.425.

Ans. $12.795.

(42.) 5 gal. molasses at $.285 = $1.425; 17 lb. sugar at

$.085 = $1.445; 15 lb. coffee at $.125 = $1.875; 7 lb. fish at $035 = $.245; 18 lb. rice at $.05 = $0.90; 2 pr. boots at $3.125 = $6.25.

Ans. $12.795 — $12.14 = $0.655.

(43.) 617 gal. at $.25 = $154.25; 874 lb. at $.195 = $170.43; 175 lb. at $.085 = $14.875.

Ans. $185.305 — $154.25 = $31.055 due to B.

(45.) 180 bu. at $.75 = $135.00; 34 bbls. at $1.875 = $63.75; 150 lb. at $2.25 per 100 lb. = $3.375 . . . cow, $35.85; 4 bbls. at $5.625 = $22.50.

Ans. Horse, $202.125 — $58.35 = $143.775.

(46, 47, 48.) Be sure that the pupil understands the principle involved in these questions, and can apply them readily in practice.

(49.) 501.758 × 514.60703 = 258,208.19,415,874.

(50.) [(80,400,080 × 5,100,700,900) + 81,700,805] — (861700 × 50.0176) = (410,096,760,416,072,000 + 81,700,805 = 410,096,760,497,772,805) — 43,100,165.92 = 410,096,760,459,672,639.08 Ans.

37b. (6.) The pupil should be frequently drilled in exercises like this example, till he can readily separate any dividend into such parts that, if possible, each order of units except the lowest will contain the divisor without a remainder. After being exercised in smaller numbers, he may find how many times each of the numbers from 2 to 9 inclusive is contained in 47175; thus:

47,175 ÷ 2 = (40000 + 6000 + 1000 + 160 + 15) ÷ 2 = 23,587½.

47,175 ÷ 3 = (30000 + 15000 + 2100 + 60 + 15) ÷ 3 = 15,725.

47,175 ÷ 4 = (40000 + 4000 + 2800 + 360 + 15) ÷ 4 = 11,793¾.

47,175 ÷ 5 = (45000 + 2000 + 150 + 25) ÷ 5 = 9435.

47,175 ÷ 6 = (42000 + 4800 + 360 + 15) ÷ 6 = 7,862⅝.

47,175 ÷ 7 = (42000 + 4900 + 210 + 65) ÷ 7 = 6,739⅔; &c.

(9.) Divide 4,108,076,094 by 3, 7, 5, 8.

Ans. 1,369,358,698; 586,868,013⅓; 821,615,218⅘; 513,509,511⅛.

NOTE.—Let the pupil prove his answers in division, by multiplication.

(11.) 6,841,754 in. = 570,146 ft. 2 in. = 190,048 yd. 2 ft. 2 in.

(12.) 71,849 fur. = 8981 m. 1 fur. = 2993 lea. 2 m. 1 fur.

(13.) 45,710,083 na. = 11,427,520 qr. 3 na. = 2,856,880 yd. 0 qr. 3 na.

(14.) 4,187,241 gi. = 1,046,810 pt. 1 gi. = 523,405 qt. = 130,851 gal. 1 qt. 1 gi.

(14.) 187,241 pt. = 93,620 qt. 1 pt. = 11,702 pk. 4 qt. 1 pt. = 2,925 bu. 2 pk. 4 qt. 1 pt.

(15.) 3,174,861 gi. = 793,715 pt. 1 gi. = 396,857 qt. 1 pt. 1 gi. = 99,214 gal. 1 qt. 1 pt. 1 gi.

(16.) 841,763qr. = 21,040d. 3qr. = 1753s. 4d. 3qr.

38b. (5.) 3,086.016 ÷ 4 = 371.504; 31,050.75 ÷ 5 = 6,210.15; 2.00,712 ÷ 8 = .25,089.

(9.) Divide 7,008.005 by 8, 9, 4, 7.

Answers, 876.000,625; 778.66,722+; 1,752.00,125.; 1,001.1,435,714+.

(14.) 30.547 ÷ .6 = 50.91,166+; 81.5007 ÷ .007 = 11,642.957,142+; .004,157 ÷ .05 = .08,314.

(15.) 4,100.7,008 ÷ .008 = 512,587.6; 817.0,035 ÷ .0009 = 907,781.666+.

39b. (10.) Divide 841,051.09 by 4000. Quot. 210. 2,627,725 . . . by 700. Quot. 1,201.50,155,714+ . . . by 90000. Quot. 9.345,012,111+.

(14.) 745,218 sec. = 12,420 min. 18 sec. = 207 h. 0 min. 18 sec.

(19, &c.) Divide 409,010,705 by 500. Quot. 818,021 $\frac{205}{1000}$. by 60000. Quot. 6,816 $\frac{50705}{60000}$. . . by 800. Quot. 511,263 $\frac{305}{800}$.

(21. &c.) 1760.0801 ÷ 70000 = .0,251,440,014+; 4.016,508 ÷ 8000 = .0,005,020,635.

40b. Long Division.

It is very important that the pupil be thoroughly drilled in all the preceding principles, before he attempts to obtain quotients by long division; the more thoroughly this is done, the more rapid and satisfactory will be his future progress.

In long division, it may not be best for the *learner* to prepare a column of products as directed in the book; his mind will be more exercised without it. More advanced pupils will find the work by

long division much easier by preparing such a series of pr
especially where the divisor is large and the quotient is to co
many figures.

(4.) 814,675 ÷ 16 = 50,917$\frac{3}{16}$. 510,011 ÷ 2
20,400$\frac{11}{25}$. 145,628 ÷ 35 = 4,160$\frac{28}{35}$.

(8.) 41,007,008 ÷ 87,000 = 471$\frac{41008}{87000}$. 15,589,47
÷ 30,700 = 507,800$\frac{15987}{30700}$.

(11.) 5,164,825 rods = 13327 m. 185 rods.

(12.) 375 miles per day = 15$\frac{15}{24}$ miles per hour.

(13.) 2600 barrels cost $13,705.87?

Ans. 5.27\frac{3}{26}$

(19.) 13.004,512 ÷ 6,080 = .0,021,389; 341.5,0
1.004 = 340.140,139; .00,075 ÷ 7,500 = .0,000
1.05,107; ÷ .00805 = 130.567,701.

The *manual* labor in obtaining a quotient by long division r
considerably diminished, by performing the subtraction witho
tually writing the several products of the divisor by the q
under the partial dividends, as in the following example:—

30.475) 40800.2684 (1338.81

103252

118276

268518

246184

33840

3365 rem.

The author has observed that Portuguese lads, from South An
generally perform division in this way, and those who have bee
drilled in the elementary rules do it very rapidly.

42a. (11.) 4,460,175 min. = 74,336 h. 15 mi
3,097 da. 8 h. 15 min. = 8 yr. 175 da. 8 h. 15 min.

(12.) 916,000 gr. = 45800 ℈. = 15266 ℥. 2 ℈. = 19
23. 2 ℈. = 159 ℔. 0℥. 2 ℥. 2 ℈.

(13.) 8,164,096 dr. = 510,256 oz. = 31,891 lb. = 11
27 lb. = 284 cwt. 2 qr. 27 lb. = 14 T. 4 cwt. 2 qr. 27

(14.) 2,289,600 in. = 190,800 ft. = 63,600 y

11,563 rd. 3.5 yd. = 289 fur. 3 rd. 3.5 yd. = 36 m. 1 fur. 3 rd. 3.5 yd.

(15.) 876,510 ft. = 292,170 yd. = 53,121 rd. 4.5 yd. = 1328 fur. 1 rd. 4.5 yd. = 166 m. 1 rd. 4.5 yd.

(16.) 681,045 in. = 302,686 na. 1.5 in. = 75,671 qr. 2 na. 1.5 in. = 18,917 yd. 3 qr. 2 na. 1.5 in.

(17.) 31,363,200 = 217,800 sq. ft. = 24,200 sq. yd. = 800 sq. rd. = 20 R. = 5 A.

(18.) 4,817,690 sq. yd. = 159,262 sq. rd. 14.5 sq. yd. = 3981 R. 22 sq. rd. 14.5 sq. yd. = 995 A. 1 R. &c. = 1 sq. m. 355 A. 1 R. 22 sq. rd. 14.5 sq. yd.

(19.) 810,650 cu. in = 469 cu. ft. 218 cu. in. = 17 cu. yd. 10 cu. ft. 218 cu. in.

(20.) 6,541 pt. = 3,270 qt. 1 pt. = 408 pk. 6 qt. 1 pt. = 102 bu. 6 qt. 1 pt.

(21.) 68,145 pt. = 34,072 qt. 1 pt. = 8518 gal. 1 pt.

(22.) 4,108,000 sec. = 68,466 min. 40 sec. = 1,141 h. 6 min. 40 sec. = 47 da. 13 h. 6 min. 40 sec.

(23.) 86,417 ÷ .231 = $374\frac{233}{231}$; 86,417 ÷ 268.8 = $321\frac{113}{268}$.

(43.) (171.84 × 10.17) ÷ .608 = 1,747.6128 ÷ .608 = 2,874.3631; 9.105 × 87,100 ÷ .00,075 = 793,045.5 ÷ .00,075 = 1,057,394,000.

42b. (1.) . . . at \$1.125 . . . for \$175.34?
Ans. $155\frac{284}{1125}$ bu.

(2.) . . . at \$6.50 . . . for \$318.50? Ans. 49 tons.

(3.) . . . 270 men \$43,500? Ans. \$161.11.

(5.) . . . 467 bbls. for \$2,626.875 1 bbl.?
Ans. \$5.625

(6.) 4,100,481qr. = 1,025,120d. 1qr. = 85,426s. 8d. 1qr. = £4271 6s. 8d. 1qr.

(11.) 32,714,684 min. = 545,244 h. 44 m. = 22,718 da. 12 h. 44 min. = 62 yr. 73 da. 12 h. 44 min.

(12.) 41,658 gr. Ap. wt. = 2082 ℈. 18 gr. = 694 ℥. 18 gr. = 86 ℥. 3 ℥. 18 gr. = 7 ℔. 2 ℥. 6 ℥. 18 gr.

(13.) 954,568 dr. = 59,660 oz. 8 dr. = 3,728 lb. 12 oz. 8 dr. = 133 qr. 4 lb. &c. = 33 cwt. 1 qr. &c. = 1 ton, 13 cwt. 1 qr. 4 lb. 12 oz. 8 dr.

(14.) 115,842 in. = 9,653 ft. 6 in. = 3,217 yd. 2 ft. &c. = 584 rd. 5 yd. &c. = 14 fur. 24 rd. &c. = 1 m. 6 fur. 24 rd. 5 yd. 2 ft. 6 in.

(15.) 15,850 ft. = 5,283 yd. 1 ft. = 960 rd. 3 yd. &c. = 24 fur. &c. = 3 m. 3 yd. 1 ft.

(16.) 79,688 in. = 35,416 na. 2 in. = 8,854 qr. 2 in. = 2,213 yd. 2 qr. 2 in.

(17.) 33,591,867 sq. in. = 233,276 sq. ft. 123 sq. in. = 2,519 sq. yd. 5 sq. ft. &c. = 856 sq. rd. 25 sq. yd. = 5 A. 1 R. 16 sq. rd. 25 sq. yd. 5 sq. ft. 123 sq. in.

(18.) 8,715,892 sq. yd. = 288,128 sq. rd. 20 sq. yd. = 7,203 R. 8 sq. rd. &c. = 1800 A. 3 R. &c. = 2 sq. m. 520 A. 3 R. 8 sq. rd. 20 sq. yd.

(20.) 8021 pt. = 4010 qt. 1 pt. = 501 pk. 2 qt. = 125 bu. 1 pk. 2 qt. 1 pt.

(22.) 684,050 sec. = 11,400 min. 50 sec. = 190 h. &c. = 7 da. 22 h. 50 sec.

(23.) 41,607 cu. in. = $180\frac{27}{231}$, w. gal. = $154\frac{2112}{2688}$ dry gal.

(24.) $\frac{4784}{27}$ = 177.22,222. $\frac{5}{8}$ = .625. $\frac{4}{7}$ = .5,714,285+. $\frac{4441}{3528}$ = 15.283,708—.

(31.) $\frac{15.008.007}{50,071}$ = 1,498$\frac{1848}{50071}$. $\frac{77.990.515}{100891}$ = 763$\frac{88312}{100891}$.

(34.) . . . 84 bu. for \$57.16? Ans. \$.68$\frac{4}{84}$.

(35.) . . . \$.625 a bu. for \$12.8125?

Ans. 20.5 bushels.

(36.) . . . \$2.125, for \$180.625? Ans. 85 bu.

(37.) . . . prod. 791,232 . . one factor 208? Ans. 3804.

(38.) . . . in 10 days? Ans. 12½ miles.

(40.) . . . 15 miles per hour?

Ans. 200 hours = 8 da. 8 h.

(43.) . . . $\frac{14.5008 \times 8.007}{.4007}$ = 217.38,533.

43a. (1.) 496 cwt.; 1986 qr.; 55,623 lb.; 889,977 oz.; 14,239,646 dr.

(2.) = 304,087 oz. = 19,005 lb. 7 oz. = 678 qr. 21 lb. &c. = 169 cwt. 2 qr. &c. = 8 tons, 9 cwt. 2 qr. 21 lb. 7 oz.

(3.) 30,947 oz.; 618,940 dwt.; 14,854,575 gr.

(4.) = 158,406 dwt. 21 gr. = 7,920 oz. 6 dwt. &c. = 660 lb. 6 dwt. 21 gr.

(5.) 235 qr.; 941 na.; 2,119.25 in.

(6.) = 96,041 qr. 1 na. = 19,208 E. E. 1 qr. 1 na.

(7.) 50,328 s.; 603,939 d.; 2,415,757 qr.

(8.) = 29,461,689d. 2qr. = 1,705,140s. 9d. &c. = £85,257 0s. 9½d.

(9.) 68,131 bu.; 272,526 pk.; 2,180,213 qt.; 4,360,426 pt.
(10.) 18,319 qt.; 36,638 pt.; 146,553 gills.
(11.) = 204,392,104 pt. 3 gi. = 102,196,052 qts. &c. = 25,549,013 gal. 3 gi.
(12.) 2,066 R.; 82,669 sq. rd.
(13.) 12 R.; 515 sq. rd.; 15,603.75 sq. yd.; 140,440.75 sq. ft.
(14.) = 21,879 R. 4 sq. rd. = 5,469 A. 3 R. 4 sq. rd.
(15.) 425 cu. ft.; 735,484 cu. in.
(16.) = 10,692 cu. ft. 413 cu. in. = 396 cu. yd. 413 cu. in.
(17.) = 14,543,409 cu. in.; = $\frac{14,543,409}{231}$ = wine gal.; $\frac{14,543,409}{282}$ = beer gal.; $\frac{14,543,409}{268.8}$ = dry gal.

43b. (1.) 1 ton 12 cwt. 3 lb. 15 dr. = 918,287 dr.
(2.) 8,594,367 dr. = 14 t. 19 cwt. 1 qr. 27 lb. 11 oz. 15 dr.
(3.) 484 lb. 11 oz. 19 dwt. 23 gr. = 2,793,599 gr.
(4.) 4,759,673 gr. = 826 lb. 3 oz. 19 dwt. 17 gr.
(5.) 6 yd. 2 qr. 3 na. 2 in. = 242.75 in.
(6.) 2,414 na. = 120 E. E. 3 qr. 2 na.
(7.) £1024 15s. 7¾d. = 983,791 qr.
(8.) 119,895 qr. = £124 17s. 9¾d.
(9.) 24 E. qr. 6 bu. 3 pk. 7 qt. 1 pt. = 12,735 pt.
(10.) 314 gal. 0 qt. 1 pt. 1 gi. = 10,053 gills.
(11.) 8,031 gi. = 250 gal. 3 qt. 1 pt. 3 gi.
(12.) 144 A. 3 R. 24 rd. = 23,184 sq. rds.
(13.) 1 A. 15 sq. rd. 8 sq. ft. = 47,651.75 sq. ft.
(14.) 4,383,706 sq. rd. = 27,398 A. 0 R. 26 sq. rd.
(15.) 18 cu. yd. 3 cu. ft. 75 cu. in. = 845,067 cu. in.
(16.) 237,945,700 cu. in. = 5100 cu. yd. 100 cu. in.
(17.) 271 cu. ft. 792 cu. in. = 469,080 cu. in. = 2030 $\frac{150}{231}$ W. gal. = 1663 $\frac{144}{282}$ B. gal. = 1741$\frac{1008}{2688}$ half pk.
(19.) 347 bu. wheat = 20,820 lb.; 347 bu. oats = 10,410 lb.
(22.) 184,800 lb = 3,080 cu. wheat = 3,300 bu. In. corn = 6,160 bu. oats.

45a. (1.) = 51,038,304.2 + 6,001 = 51,044,305.2.
(2.) $85.00 — $64.12 = $20.88; and $\frac{2088}{18}$ = 116 lb.
(3.) $15 - 4\frac{5}{24} \times 15 = 10\frac{19}{24} \times 25 = 421\frac{3}{24}$.
(4.) Pork, $37.375; hay, $45; carrots, $12 = $94.375;

flour, $13.00; fish, $2.25; sugar, $1.37½; rice, $.60; cloth, $1.74 = $18.965. Ans. $94.375 — $18.965 = $75.41.

(5.) $.02½ × 190 = $4.75.

(6.) Fore quarters, $37.51; hind quarters, $39.00; hide, $4.875; tallow, $5.04. Ans. $86.425.

(7.) Paper, $38.94; printing, $18.00; binding, $125. Ans. $181.94; $0.182 nearly.

(8.) Ans. $\frac{\$257 + \$55.50}{50} = \frac{\$312.50}{50} = \$6.25$.

(10.) House-rent, $65; wood, $27. Ans. $445.15 — $344.27 = $100.88.

(11.) 365.25 da. × 13 = 4748.25 da. at 1 ct. per da. = $47.4825; 365.25 × 20 = 7305 da. at 2½ cts. = $182.625; and $47.4825 + $182.625 = $230.1075.

(13.) 75 ÷ .075 = 75,000 ÷ 75 = 1000.

(16.) Molasses, $31.35. Ans. 3135 ÷ 57 = 55 bu.

(19.) $.375 × 435 = $163.125.

(20.) 63 cts. per bushel.

(21.) Barley, $13.25; corn, $42.25. Ans. 32 ÷ 16 = 2 tons.

(22.) Cloth, $1462.50, + freight, $6, + duties, $526.50, + other expenses, $5.50, = $2000.50; and $2000.50 ÷ 390 = $5.13—.

(23.) $2100.50 ÷ 390 = $5.386—.

(24.) The 1st, $20.15; 2d, $60.45; 3d, $80.60; 4th, $86.20. Ans. $350.54 — $247.40 = $103.14.

(25.) Flour, $155. Ans. $155 ÷ 28 = $5.536.

(33.) $300 × .25 = $75; $300 × .35 = $105; $300 × .33 = $99. He has paid $279, and he still owes $300 — $279 = $21.

(36.) 20,495s.; 245,947d.; 983,791qr.

(37.) = 29,973d. = 2,497s. 9d. = £124 17s. 9d.

(38.) = 41,666 dwt. 16 gr. = 2,083 oz. 6 dwt. &c. = 173 lb. 7 oz. 6 dwt. 16 gr.

(39.) 5819 oz.; 116,399 dwt.; 2,793,599 gr.

(40.) 496 cwt.; 1,986 qr.; 55,623 lb.; 889,977 oz.; 14,239,646 dr.

(41.) = 40,493 oz. 7 dr. = 2,530 lb. 13 oz. 7 dr.

(42.) = 45,664 ft. = 15,221 yd. 1 ft.

(43.) = 2,591 sq. ft. = 373,236 sq. in.

(44.) = 85,733 sq. ft. 126 sq. in. = 9,525 sq. yd. 8 sq. ft. 126 sq. in.

(46.) = 25,327 cu. ft. 891 cu. in. = 938 cu. yd. 1 cu. ft. 891 cu. in.

(47.) ; 8765 h.; 525,948 min.; 31,556,937 sec.

45b. (1.) (340,010.017 × 20,005) + 80,040 = 6,801,980,430.085.

(2.) A borrowed \$148 . . . paid \$80.17 + \$5.125 + \$.875 . . . butter at 19 cts.?

Ans. Unpaid, \$61.83 = $325\frac{8}{19}$ lb. at 19 cts.

(3.) 27 fir., each 57 lb., at \$.165 . . . molasses at 27 cts.?

Ans. $\$\frac{249.975}{27} = 940.5$ gal.

(4.) 547 lb. pork, at $5\frac{1}{4}$ cts.; $3\frac{1}{2}$ tons hay, at \$.63 per cwt.; $1\frac{1}{2}$ tons carrots, at \$10 . . . received in pay, 3 bbls. flour, at \$5.75; 30 lb. fish, at $3\frac{1}{2}$ cts.; 16 lb. sugar, at $7\frac{1}{2}$ cts.; 19 lb. rice, at 5 cts.; 30 yds. cloth, at $8\frac{1}{4}$ cts.?

Ans. Balance = $\$87.81\frac{3}{4} - \$22.92\frac{1}{2} = \$64.89\frac{1}{4}$.

(5.) 4 bu. 3 pk. 1 qt., at $2\frac{1}{4}$ cts. per qt.? Ans. $\$3.44\frac{1}{4}$.

(6.) . . . fore qrs., 257 lb. each, at $7\frac{1}{2}$ cts.; hind do., 250 lb. each, at $8\frac{1}{4}$ cts.; hide, 60 lb., at 7 cts.; tallow, 54 lb., at $7\frac{1}{2}$ cts.?

Ans. $\$87.91\frac{1}{4}$.

(7.) . . . paper, 15 reams, each $28\frac{1}{2}$ lb., at 10 cts.; printing, $\$1.62\frac{1}{2}$ per ream; binding, $8\frac{1}{4}$ cts. . . . 1000 copies?

Ans. $\$149.62\frac{1}{2}$; \$.149625 = 15 cts. nearly.

(8.) . . . 100 bbls. for \$562.50 . . . gain, \$74.20?

Ans. \$6.367.

(9.) 56 . . . \$758? Ans. \$424.48; \$333.52.

(10.) . . . 295 days, \$1.625 per day . . . rent, \$60.00; 5 C. wood, at \$5.25; other expenses, \$285.15 . . . ?

Ans. \$479.375 — \$371.40 = \$107.975.

(11.) . . . $1\frac{1}{2}$ cts. per day till he is 30 years old, $2\frac{1}{4}$ cts. till he is 60? Ans. \$71.22375 + \$246.54375 = \$317.7675.

(13.) . . . at \$.065, for \$65.65?

Ans. 1010 lb.; 5 bbls. and 10 lb. over.

(14.) . . . 3 lb. 8 oz. 18 dwt. . . . each spoon, 15 dwt.?

Ans. 898 dwt.; 59 spoons and 13 dwt.

(15.) . . . 75 yd. 2 qr. . . . each coat 1 yd. 3 qr.?

Ans. 43 coats and 1 qr. over.

(16.) . . . 247 gal. at 23 cts. . . . potatoes, at 75 cts.?

Ans. $75\frac{4}{5}$ bu.

(17.) . . . 1 bbl. cost \$6.86 . . . ?

Ans. 1 lb. = \$.035; 5 lb. = \$.175; 22 lb. = \$.77.

(18.) . . . 23lb. . . . \$1.955 . . . 16lb.? Ans. \$1.36.

(19.) . . . 4 cwt. 2 qr. 18 lb. . . . at \$.625?

Ans. \$326.25.

(20.) . . . 175 bu. . . . $117.25 . . . 28 bu. ?
Ans. $18.76.

(21.) . . . owed $113.35 . . . 18 bu. barley, at 45 cts., 75 bu. corn, at $.75 . . . hay, at $14 ? Ans. 3½ tons.

(22.) . . . 3 bales, each 205 yards, cost in London $2.25 per yd.; freight, $5.50; duties, $1.50 per yd.; other expenses, $3,90 ?

Ans. $2315.65; 3.76\frac{324}{615}$ = 3.765\frac{189}{615}$ per yard.

(23.) . . . to gain $150 ?
Ans. $2465.65; 4.009\frac{11}{61}$ per yd.

(24.) . . . $475.25 among 5 men; first, $30.25; 2d, twice as much; 3d, as much as the 1st and 2d; the 4th, as much as the 2d and 3d, wanting $43. . . . 5th ? Ans. $185.50.

(25.) 15 bbls. at $5.75 for 24 cords. . . . per cord ?
Ans. $3.594—.

(26.) . . . 200 lb. for $30, sold for $35. . . . gain per lb. ?
Ans. $.025.

(27.) . . . 375 lb. . . . $31.875. . . . gain, $5.625 ?
Ans. 10 cts.

(28.) . . . 5 yds. . . . $16.50 . . . for $90.75 ?
Ans. 27½ yds.

(29 & 30.) . . . 8 shares at $92.50 . . . how many acres at $23.125 ? Ans. 32 A.

(31 & 32.) . . . the int. of $350 for 1 year at 5½ per ct. = $19.25; at 6½ per cent. = $22.75; . . . of $475 for 2 yrs. at 5 per ct. = $47.50; for 3½ yrs. at 4 per ct. = $66,50; for 2¼ yrs. at 5 per cent. = $53.4375.

(33.) . . . owing $508, has paid .64, .12, and .08 ?
Ans. $81.28.

(34.) If 7 horses eat 19 bu. 1 pk., 6 horses will eat 16 bu. 2 pk.; 35 horses will eat 96 bu. 1 pk.

(35.) If 1 oz. is worth $1.20, 10 oz. 13½ dwt. are worth $12.81.

(36.) £25 8s. 9¾d. = 24,243 qr.

(37.) 2,836,834 qr. = £2955 0s. 8½d.

(38.) 10,000 gr. = 1 lb. 8 oz. 16 dwt. 16 gr.

(39.) 20 lb. 10 oz. 15 gr. = 120,015 gr.

(40.) 5 T. 3 qr. 7 oz. = 2,888,816 dr.

(41.) 217,614 dr. = 7 cwt. 2 qr. 10 lb. 14 dr.

(42.) 54,090 in. = 1502 yd. 1 ft. 6 in.

(43.) 5 sq. yd. 5 sq. ft. 37 sq. in. = 7237 sq. in.

(44.) 138,300 sq. in. = 106 sq. yd. 6 sq. ft. 60 sq. in.

(45.) 3½ cu. yd. = 163,296 cu. in.

(46.) 139,300 cu. in. = 2 cu. yd. 26 cu. ft. 1060 cu. in.
(47.) 3 solar yrs. = 94,670,811 sec.
(48.) . . . from July 8 to Dec. 15? 160 da.; from Sept. 15, 1849, to Feb. 19, 1850? 157 da.; from Feb. 3, 1848, to Jan. 15, 1849? 347 da.; from April 12, 1851, to Mar. 17, 1852? 340 da.

46a. (1.) Letter paper, $26.25; col'd. do., $12; foolscap do., $16.50; demy do., $99. Am't. $153.75
(2.) Silk, $14.62½; shawls, $19; buttons, $.25. Am't. $33.875.
(3.) Files, $22.75; nails, $.60; chisels, $4.50. Am't. $27.85.
(4.) Broadcloth, $69.75; cotton, $7.14; cambric, $4.75; chintz, $2.94; silk, $15. Am't. $99.58.
(5.) Nails, $7.67; lead, $3; hinges, $2.25; do., $1.38. Am't. $14.30.
(6.) Pork, $30.87½; beef, $13.55¾; butter, $14.25; cheese, $3.61; potatoes, $8.70; squashes, $1.68¾. Am't. $72.68.
(7.) Arithmetics, $1.35; sequels, $7.50. Am't. $8.85.

(8.) *Hartford, Jan.* 17, 1849.

Mr. PHILIP R. STETSON,
Bought of HENRY OSGOOD,

75 gals.	Molasses,	at	$0.28,	$21.00.
48 lb.	Sugar,	"	0.10½,	5.04.
3 bush.	Grass Seed,	"	2.12½,	6.37½.
150 lb.	Salt Fish,	"	0.05½,	8.25.
5 yds.	Broadcloth,	"	3.25,	16.25.
				$56.91½.

(9.) *Danvers, Nov.* 15, 1848.

Mr. WILLIAM DANIELS,
Bought of TIMOTHY PRESTON,

5 bush.	Potatoes,	at	$0.75,	$3.75.
75 lb.	Squashes,	"	0.02½,	1.87½.
3 bbls.	Apples,	"	1.75,	5.25.
2 bush.	Turnips,	"	0.37½,	0.75.
10 gal.	Milk,	"	0.18,	1.80.
25 bunches	Onions,	"	0.02½,	0.62½.
				$14.05.

(11.) *New York, March* 17, 1849.

Messrs. WASHINGTON, MARSHALL & Co.

Bought of BRETT & PRICE,

10	pairs	Gaiter Shoes,	at $4.00,	$40.00.
15	"	Calf Boots,	" 3.75,	56.25.
12	"	French Shoes,	" 2.25,	27.00.
9	"	Kip Boots,	" 1.25,	11.25.
				$134.50.

(12.) *Boston, April* 7, 1849.

Messrs. B. B. MUSSEY & Co.

Bought of TAPPAN, WHITTEMORE & MASON,

50	American School Readers,	at $0.50,	$25.00.
25	Introduction to do.,	" 0.30,	7.50.
50	Russell's Sequel,	" 0.20,	10.00.
75	Russell's Primary Reader,	" 0.13,	9.75.
25	Introduction to do.,	" 0.10,	2.50.
100	Primers,	" 0.06¼,	6.25.
			$61.00.

47a. The solution of the examples in this article is so short and easy, that pupils will generally be able to do most of them without the aid of slate and pencil. The mode of operation need not be even indicated here.

47b. (11.) If 9 men . . . 31 days, . . . 16 men?
Ans. $17\frac{7}{16}$ da.

(12.) If $50 . . . 8 men, 40 da., . . . 12 men? 25 men?
Ans. $26\frac{8}{12}$ da.; $12\frac{32}{25}$.

(13.) If . . . 225 m. in 9 h., . . . 5½ h.? 10¼ h.?
Ans. 137½ m.; 256¼ m.

(14.) If 25 bbls. cost $35, . . . 8 bbls.? 15 bbls.?
Ans. $11\frac{5}{25}$; $21.

(15.) . . . 105 sheep for $236.25, . . . 27 sheep?
Ans. $60.75.

(16.) . . . 15 bbls. for $93.75, . . . 9 bbls.? 23 bbls.?
Ans. $56.25; $143.75.

(17.) If $3\frac{5}{8}$ tons cost $29, . . . 7½ tons? 9¼ tons?
Ans. $60; $74.

(18.) Bought $15\frac{3}{5}$ cords for $117, . . . 9 cords? $67½.

(19.) Gave $38 for $8\frac{1}{8}$ yds., . . . 15 yds.?
Ans. $67.50.

(23.) . . . $8\frac{1}{8}$ bu. for \$6.60, . . . $8\frac{1}{2}$ bu.? $7\frac{3}{8}$ bu.?
Ans. \$6.37½; \$5.70.

(25.) . . . \$1.72 for $5\frac{3}{8}$ gal.? . . . 1 gal.? $3\frac{3}{8}$ gal.?
Ans. \$.32; \$1.08.

(27.) If 18 gal. 3 qt. cost \$28.50, . . . per gal.? $5\frac{1}{4}$ gal.?
Ans. \$1.52; \$7.98.

64b. (1.) Add £272 18s. 9d.; £19 6s. 6d. 3qr.; 15s. 3qr.; and £190 6s. 7d. 2qr. Ans. £483 7s.

(2.) . . . 4 T. 3 cwt. 15 lb.; 1 T. 17 cwt. 1 qr.; 3 T. 3 qr. 25 lb. . . . ? Ans. 9 T. 1 cwt. 1 qr. 12 lb.

(3.) Add 4 lb. 8 oz. 15 gr.; 13 lb. 6 dwt.; 8 oz. 21 gr.; 3 lb. 5 dwt. 18 gr. Ans. 21 lb. 4 oz. 13 dwt. 6 gr.

(4.) . . . 3 m. 2 fur. 5 yd. 4 in; 1 m. 25 rd. 1 ft. 11 in.; and 3 fur. 18 rd. 1 yd. 8 in.?
Ans. 4 m. 6 fur. 4 rd. ½ yd. 2 ft. 11 in.

(6.) Add 5 A. 1 R. 13 sq. rd. 8 sq. ft. 15 sq. in.; 3 A. 29 sq. rd. 15 sq. yd. 115 sq. in. and 2 R. 5 sq. yd. 6 sq. ft. 127 sq. in.
Ans. 9 A. 0 R. 2 sq. rd. 21 sq. yd. 6 sq. ft. 113 sq. in.

(9.) Add 15 bu. 5 qt.; 3 pk. 6 qt.; 18 bu. 3 pk. 7 qt.
Ans. 35 bu. 0 pk. 2 qt.

(11.) Add 3 yr. 324 da. 5 h. 3 min. 54 sec.; 175 da. 16 min; 5 yr. 185 da. 14 h.; and 7 yr. 6 h. 45 sec.
Ans. 16 yr. 319.75 da. 1 h. 20 min. 39 sec.

65b. (2.) £17 3s. 8d. 2qr. — £9 15s. 6d. 3qr. = £7 8s. 1d. 3qr.

(3.) 14 T. 3 qr. 15 lb. 8 dr. — 15 cwt. 25 lb. 6 oz. = 13 T. 5 cwt. 2 qr. 17 lb. 10 oz. 8 dr.

(4.) 8 m. 26 rd. 3 yd. 2 ft. 3 in. — 3 m. 2 fur. 30 rd. 5 yd. 1 ft. 9 in. = 4 m. 5 fur. 35 rd. $3\frac{1}{2}$ yd. 0 ft. 6 in.

(6.) 16 bu. 0 pk. 1 qt. — 3 bu. 1 pk. 7 qt. = 12 bu. 2 pk. 2 qt.

(7.) 6 fur. 27 rd. 0 yd. 2 ft. 5 in. — 37 rd. 5 yd. 2 ft. 7 in. = 5 fur. 28 rd. 5 yd. 2 ft. 10 in.

(8.) 6 A. 35 sq. rd. 6 sq. ft. — 3 R. 30 sq. yd. 6 sq. ft. 25 sq. in. = 5 A. 1 R. 33 sq. rd. 29.5 sq. yd. 8 sq. ft. 119 sq. in.

(9.) 115 da. 15 m. — 14 da. 18 h. 25 m. 34 sec. = 100 da. 5 h. 49 m. 26 sec.

(12.) 3 S. 18° 21″ — 5 S. 30′ 47″ = 10 S. 17° 29′ 34″.

66b. (2.) 41 bu. 3 pk. 7 qt. 1 pt. × 7 = 293 bu. 3 pk. 4 qt. 1 pt

(4.) 35 lb. 10 oz. 17 dwt. 5 gr. × 8 = 287 lb. 2 oz. 17 dwt. 16 gr.

(6.) 35 m. 6 fur. 20 rd. 5 yd. 4 in. × 24 = 4 × 6. Multiply first by 6, then by 4.

Prod. by 6 = 214 m. 7 fur. 5 rd. 2½ yd. 2 ft. 0 in.

Prod. by 6 × 4 = 859 m. 4 fur. 22 rd. 1 yd. 2 ft. 0 in.

67b. (3.) Divide £18 4s. 8d. 3qr. by 5; by 28.

Ans. £3 12s. 11d. 1⅗qr.; 13s. 1$\frac{7}{28}$qr.

(5.) Divide 3 m. 2 fur. 3 yd. 2 ft. 0 in. by 6; by 30.

Ans. 4 fur. 13 rd. 2 yd. 1 ft. 4 in.; 34 rd. 3 yd. 2 ft. 4⅘ in.

(7.) Divide 17 A. 2 R. 18 sq. rd. 22 sq. yd. 7 sq. ft. 11 sq. in. by 7; by 28.

Ans. 2 A. 2 R. 2 sq. rd. 20 sq. yd. 4 sq. ft. 125 sq. in.; 2 R. 20 sq. rd. 20 sq. yd. 2 sq. ft. 49½ sq. in.

For more exercises in multiplication and division of compound numbers, see arithmetic, pages 108 and 111.

68b. (1.) If 9 yds. cost £13 6s. 3d., . . . 7 yds.?

Ans. £10 7s. 1d.

(2 & 3.) 4 cwt. 1 qr. 8 lb.; 2 cwt. 3 qr. 24 lb.; 5 cwt. 20 lb. . . . at 7¼ cts.?

Ans. 12 cwt. 1 qr. 24 lb. = 1396 lb. = $101.21.

(6.) 48 lb. 13 oz.; 76 lb. 10 oz.; 85 lb. 11 oz.; 57 lb. 5 oz.; and 75 lb. 9 oz., . . . at $.14½? Ans. 344 lb.; $49.88.

(9.) . . . 25 yds. at £1 4s. 6¼d. = £30 13s. 0½d. . . . If he gain £7 4s. 6d., the price per yd. would be £1 10s. 3d. 2$\frac{11}{25}$qr.

(10.) 45 m. 1 fur. 28 rd. 2 yd. 2 ft. in 4 hours. . . . ?

Ans. 11 m. 2 fur. 17 rd. 0 yd. 2 ft.

(17.) . . . 75 A. 3 R. 25 rd. . . . 8 fields, . . . ?

Ans. 9 A. 1 R. 38⅛ sq. rd.

69b. (4.) . . . From May 3d to Nov. 25th = 6 mo. 21 da.

From Mar. 15th to Nov. 13th = 7 mo. 29 da.

From July 12, 1847, to April 3d, 1848 = 8 mo. 22 da.

From Nov. 15, 1836, to June 27, 1842 = 5 yr. 7 mo. 12 da.

From June 15, 1842, to Mar. 7, 1848 = 5 yr. 8 mo. 21 da.
From Jan. 18, 1849, to Dec. 19, 1852 = 2 yr. 11 mo. 1 da.

70b. (4.) . . 336 in. long, 21 in. wide?
Ans. 7056 sq. in. = 49 sq. ft.
(5.) . . 14 ft. long, 14.5 wide?
Ans. 203 sq. ft.; $4\frac{7}{9}$ boards.
(6.) . . 1 ft. 7 in. wide, 13 ft. 3 in. long?
Ans. 3,021 sq. in. = $20\frac{1}{4}\frac{1}{4}$ sq. ft.
(7, 8, 9 & 10.) A room 16 ft. wide, 18 ft. long, 9 ft. high? . . The walls contain 612 sq. ft.; the ceiling and floor, each 288 sq. ft.; the walls and ceiling together, 900 sq. ft. = 100 sq. yd., which, at $8\frac{1}{2}$ cts. per sq. yd., comes to $8.50, the plastering; the flooring, at $4\frac{1}{2}$ cts. per sq. ft., comes to $12.96.
(11.) . . 4 windows, 12 panes each, the panes being 10 by 12; . . . $6\frac{1}{4}$ cts. per sq. ft.? Ans. 40 sq. ft.; $2.50.
(12.) . . 17 ft. long, 15 ft. wide, 10 ft. high?
Ans. 895 sq. ft. = $99\frac{4}{9}$ sq. yd.
(13.) . . 25 rods wide, 54 rods long?
Ans. 1350 sq. rd. = $8\frac{7}{16}$ A.
(14.) . . $3\frac{1}{2}$ rods wide, 3 miles long? Ans. 21 acres.
(15.) . . 8 rods long, $5\frac{1}{2}$ rods wide, at $6\frac{1}{4}$ cts. per sq. ft.?
Ans. $748.68\frac{3}{4}$.
(18.) . . 8 ft. long, $5\frac{1}{2}$ ft. wide, $2\frac{1}{2}$ ft. thick, at $5\frac{1}{4}$ cts. per cu. ft.? Ans. 110 cu. ft. = $5.77\frac{1}{2}$.
(20.) . . 7 loads, each $9\frac{1}{2}$ ft. long, 4 ft. wide, $5\frac{1}{2}$ ft. high?
Ans. 1463 cu. ft. = 11 C. 3 C. ft. 7 cu. ft.
(21.) . . 15 ft. long, 10 ft. wide, 8 ft. high, at $3.75?
Ans. 9.375 C.; $35.15,625.
(22.) . . 7 ft. 4 in. long, 5 ft. 3 in. wide, 4 ft. thick?
Ans. 266,112 cu. in. = 154 cu. ft.
(23.) . . tons . . 13.5 cu. ft. per ton?
Ans. $11\frac{1}{2}\frac{1}{4}$ tons = 11.4074 cu. ft.
(24.) . . 6 ft. long, $7\frac{1}{2}$ ft. high, 5 ft. wide?
Ans. 1,687.5 gal.

71b. (8.) The prime factors of 3420 are 2^2, 3^2, 5, 19; of 18,500 are 2^2, 5^3, 37.

72b. The greatest com. meas. of 324 and 586 is 2; . . . of 582 and 684 is 6; . . . of 12, 18, 24, 30, and 36 is 6.

73b. The least com. mult. of 2, 3, 4, 5, 6, 7, and 8, is 840; . . . of 9, 4, 12, 3, and 6, is 36; . . . of 8, 9, 10, 12, 18 and 27, is 1080.

74b. $\frac{5 \times 8 \times 7 \times 24 \times 8}{25 \times 4 \times 21 \times 12} = \frac{32}{15} = 2\frac{2}{15}$.

$\frac{35 \times 28 \times 9 \times 20}{18 \times 7 \times 40} = 35$. $\frac{42 \times 45 \times 38 \times 54}{7 \times 9 \times 95} = 648$.

77b. $\frac{72}{252} = \frac{2}{7}$; $\frac{72}{120} = \frac{3}{5}$; $\frac{72}{132} = \frac{6}{11}$; $\frac{324}{342} = \frac{18}{19}$.

78b. (5, &c.) $\frac{72}{9} = 8\frac{3}{3}$; $\frac{315}{24} = 13\frac{1}{8}$; $\frac{3041}{21} = 145\frac{2}{7}$; $\frac{13824}{144} = 96\frac{3}{4}$.

(10.) $\frac{3}{17} = .17,647+$; $\frac{351}{1057} = .033,112+$; $\frac{4}{2005} = .00,199,104+$.

(12.) $\frac{27}{4} = 6.75$; $\frac{45}{7} = 6.428,571+$; $\frac{1015}{107} = 93.59,813+$.

(19.) $45\frac{3}{8} = \frac{363}{8}$; $75\frac{4}{15} = \frac{1129}{15}$; $841\frac{4}{25} = \frac{21029}{25}$.

(22, &c.) $.45 = \frac{9}{20}$; $.024 = \frac{3}{125}$; $3.5 = \frac{7}{2}$; $8.75 = \frac{35}{4}$; $30.77 = \frac{3077}{100}$; $205.48 = \frac{5137}{25}$; $15 = \frac{15}{1}$.

81b. $\frac{38}{15} \times 25 = \frac{38}{3} = 12\frac{2}{3}$; $\frac{87}{27} \times 9 = \frac{87}{3} = 29$; $215\frac{41}{49} \times 7 = 1505\frac{41}{7} = 1510\frac{6}{7}$; $1684\frac{3}{25} \times 5 = 8420\frac{3}{5}$.

(8.) $\frac{2564}{15} \div 16 = \frac{641}{15} = 3\frac{2}{5}$; $\frac{48}{97} \div 24 = \frac{2}{97}$; $\frac{75}{127} \div 15 = \frac{5}{127}$.

(10.) $10,476\frac{3}{8} \div 7 = 1496\frac{5}{8}$; $5104\frac{5}{12} \div 9 = 567\frac{17}{108}$; $8,417\frac{15}{23} \div 300 = 28\frac{203}{3450}$.

NOTE.—The pupil should be required to perform the above divisions according to the process indicated in the text-book. [See Art. 80, quest. 11, and the note to quest. 19.]

82b. $\frac{11}{17}$ of $\frac{1}{20}$ of $\frac{1}{2}$ of $\frac{3}{4}$ of $14 = \frac{231}{1360}$; $\frac{7}{11}$ of $\frac{15}{16}$ of $\frac{8}{9}$ of $12 = \frac{70}{11} = 6\frac{4}{11}$.

.3 of $\frac{4}{5}$ of .15 of $\frac{25}{32}$ of $1.33 = \frac{11997}{320000}$.

$\frac{4}{5}$ of .5 of $\frac{15}{19}$ of $\frac{28}{45}$ of $5\frac{1}{4} = \frac{7}{5} = 1\frac{2}{5}$.

NOTE.—Let the pupil cancel the common factors, as directed in the rule, so that the result of the multiplication may be in its lowest terms.

83b. (1.) $\frac{5}{12} = .41\dot{6}$; $\frac{13}{18} = .7\dot{2}$; $4\frac{3}{22} = 4.13\dot{6}$; $3\frac{506}{111} = 3.\dot{5}0\dot{4}$.

(2 & 3.) $.\dot{7} = \frac{7}{9}$; $.\dot{9}0\dot{6} = \frac{906}{999} = \frac{302}{333}$; $6.\dot{5}0\dot{7} = 6\frac{169}{333}$;

$.5\dot{4} = \frac{4\,8}{9\,0}$; $.1\dot{0}\dot{7} = \frac{1\,0\,6}{9\,9\,0} = \frac{5\,3}{4\,9\,5}$; $3.0\dot{1} = \frac{3\,0\,1\,0}{9\,9\,9} = 3\frac{1\,3}{9\,9\,9}$; $30.00\dot{1} = 30\frac{1}{9\,9\,9\,0}$.

84b. (8.) $\frac{5}{1\,2} = \frac{1\,0}{2\,4} = \frac{1\,5}{3\,6} = \frac{2\,0}{4\,8} = \frac{2\,5}{6\,0}$, &c.; . . . $\frac{5}{1\,8} = \frac{1\,0}{3\,6} = \frac{1\,5}{5\,4} = \frac{2\,0}{7\,2} = \frac{2\,5}{9\,0}$, &c.

(11.) $\frac{3}{7}$ lb. $= 6\frac{6}{7}$ 16ths of a lb.; $\frac{1}{8}$ oz. Troy $= 12\frac{1}{2}$ 20ths of an oz.

(12.) $\frac{8}{1\,1}$ da. $= 6\frac{8}{1\,1}$ 24ths of a da.; $\frac{3}{8}$ min. $= 22\frac{1}{2}$ 60ths of a min.

85b. (7.) $\frac{3}{5}, \frac{5}{6}, \frac{7}{1\,5} = \frac{5\,4}{9\,0}, \frac{7\,5}{9\,0}, \frac{3\,5}{9\,0}$; $\frac{4}{5}, \frac{7}{1\,5}, \frac{9}{2\,0}, \frac{3\,4}{4\,5} = \frac{1\,4\,4}{1\,8\,0}, \frac{8\,4}{1\,8\,0}, \frac{8\,1}{1\,8\,0}, \frac{1\,3\,8}{1\,8\,0}$.

(8.) $\frac{3}{8}, \frac{4}{9}, \frac{5}{1\,2}, \frac{7}{1\,8}, \frac{1\,7}{2\,4}, \frac{2\,2}{4\,5} = \frac{1\,3\,5}{3\,6\,0}, \frac{1\,6\,0}{3\,6\,0}, \frac{1\,5\,0}{3\,6\,0}, \frac{1\,4\,0}{3\,6\,0}, \frac{2\,5\,5}{3\,6\,0}, \frac{2\,2\,2}{3\,6\,0}$.

86b. (9 & 12.) 17s. $8\frac{3}{4}$d. $= £\frac{8\,8\,1}{9\,6\,0} = (£.88,646—.)$

(10 & 13.) 5 oz. 8 dwt. 20 gr. $= \frac{2\,6\,1\,2}{5\,7\,6\,0} = \frac{6\,5\,3}{1\,4\,4\,0}$ lb. $=$.45,374+ lb.

(11 & 14.) 2 qt. 1 gi. $= \frac{1\,7}{3\,2}$ gal. $=$.53,125 gal.

(17.) 26 rd. 5 yd. $= \frac{1\,4\,8}{1\,7\,6\,0} = \frac{3\,7}{4\,4\,0}$ m. $=$.08,40$\dot{9}$.

(20.) 1 R. 25 sq. yd. $=$.25,516,526 A.

(21.) 185 da. 14 h. 35 sec. $=$.5081+ yr.

(22.) What part of 13 da. 5 h. 47 min. is 2 da. 34 min. 15 sec.? Ans. $\frac{1\,8\,8\,8\,8}{1\,9\,5\,8\,7}$.

(24.) What part of 2 m. 3 fur. 2 rd. are 6 rd. 10 ft.? Ans. $\frac{1\,1\,9\,8}{1\,2\,5\,7\,3}$.

(26.) . . . \$18 is \$.045? Ans. $\frac{4\,5}{1\,8\,0\,0\,0} = \frac{1}{4\,0\,0}$. . . of \$12.40 is \$3.005? Ans. $\frac{3\,0\,0\,5}{1\,2\,4\,0\,0} = \frac{6\,0\,1}{2\,4\,8\,0}$.

What part of \$15.05 is \$12? \$8.005? \$30.12? Ans. $\frac{2\,4\,0}{3\,0\,1}$; $\frac{1\,6\,0\,1}{3\,0\,1\,0}$; $\frac{3\,0\,1\,2}{1\,5\,0\,6}$.

87a. (7.) Say, Since 1 peck is equal to 2 gallons, and 1 gallon is equal to 4 quarts, and 1 quart is equal to 2 pints, there will be two times as many gallons as pecks, 4 times as many quarts as gallons, and 2 times as many pints as quarts; therefore, $\frac{3}{1\,0\,8}$, or $\frac{1}{3\,6}$ of a pk. $= \frac{1}{1\,8}$ of a gal. $= \frac{2}{9}$ of a qt. $= \frac{1}{9}$ of a pt. $\frac{5}{3\,6}$ of a gal. $= \frac{5}{9}$ of a qt. $= \frac{1\,0}{9}$ of a pt.

$\frac{8}{6\,7}$ or $\frac{2}{2\,7}$ bu. $= \frac{8}{2\,7}$ pk. $= \frac{1\,6}{2\,7}$ gal. $= \frac{6\,4}{2\,7}$ qt. $= \frac{1\,2\,8}{2\,7}$ pt.; because there are in any quantity, 4 times as many pecks as bushels, 2 times as many gallons as pecks, &c.

(8.) Say, Since 1 pt. $= \frac{1}{2}$ qt., and 1 qt. $= \frac{1}{4}$ gal., there will

be $\frac{1}{2}$ as many quarts as pints, and $\frac{1}{4}$ as many gallons as quarts. .4 pt. = .2 qt. = .05 gal.

Let the pupil explain all the solutions in the same way.

(9.) $\frac{5}{100}$ cwt. = $\frac{5}{27}$ qr. = $\frac{140}{27}$ lb.; $\frac{3}{85}$ qr. = $\frac{84}{85}$ lb.

(11.) $\frac{4}{5}$ gr. = $\frac{1}{54}$ dwt. = $\frac{1}{1080}$ oz. = $\frac{1}{12,960}$ lb. $\frac{3}{16}$ dwt. = $\frac{3}{320}$ oz. = $\frac{1}{1280}$ lb.

(12.) $\frac{5}{11}$ rd. = $\frac{1}{88}$ fur. = $\frac{1}{704}$ m.

(13.) $\frac{4}{5}$ sq. rd. = $\frac{1}{50}$ R. = $\frac{1}{200}$ A.

(14.) .085 qr. = .34 na., or $\frac{85}{1000}$ qr. = $\frac{17}{50}$ na. .17 yd. = .68 qr. = 2.72 na.

(15.) .08 yd. = .24 ft. = 2.88 in.

II. (16.) $\frac{4}{15}$ ft. = $\frac{4}{45}$ yd. = $\frac{8}{495}$ rd. = $\frac{1}{247.5}$ fur. = $\frac{1}{1980}$ m.; $\frac{16}{25}$ in. = $\frac{4}{75}$ ft. = $\frac{4}{225}$ yd. = $\frac{8}{2475}$ rd. = $\frac{1}{12,375}$ fur. = $\frac{1}{9900}$ m.

(17.) $\frac{1}{8}$ sq. yd. = $\frac{1}{242}$ sq. rd. = $\frac{1}{9680}$ R. = $\frac{1}{38,720}$ A. $\frac{4}{7}$ sq. ft. = $\frac{4}{63}$ sq. yd. = $\frac{16}{7623}$ sq. rd. = $\frac{2}{38115}$ R. = $\frac{1}{76,230}$ A.

(18.) = $\frac{5}{8}$ da. × $\frac{4}{1461}$ = $\frac{20}{13,149}$ yr.; $\frac{7}{8}$ h. = $\frac{7}{192}$ da. = $\frac{7}{701.28}$ yr.

(19.) .0003 yr. = .109,575 da. = 2.6298 h. = 157.788 min.; or .$\frac{3}{10000}$ yr. = $\frac{438}{400000}$ da. = $\frac{1314}{50000}$ h. = $\frac{3944}{2500}$ min. .04 wk. = .28 da. = 6.72 h. = 403.2 min.; or, $\frac{4}{100}$ = $\frac{1}{25}$ wk. = $\frac{7}{25}$ da. = $\frac{168}{25}$ h. = $\frac{2016}{5}$ min.

(20.) $\frac{35}{100}$ yd. = $\frac{7}{20}$ yd. = $\frac{7}{110}$ rd. = $\frac{7}{4400}$ fur. = $\frac{7}{35,200}$ m.; .106 ft. = $\frac{53}{500}$ ft. = $\frac{53}{1500}$ yd. = $\frac{53}{8250}$ rd. = $\frac{53}{330,000}$ fur. = $\frac{53}{2,640,000}$ m.

(21.) .0006 m. = .0048 fur. = .192 rd. = 1.056 yd. = 3.168 ft. = 38.016 in.; or, .0006 m. = $\frac{3}{5000}$ m. = $\frac{3}{625}$ fur.; $\frac{24}{125}$ rd. = $\frac{132}{125}$ yd. = $\frac{396}{125}$ ft. = $\frac{4752}{125}$ in.; .35 rd. = 1.925 yd. = 5.775 ft. = 69.3 in.

(22.) The part of 3 inches will be $\frac{1}{3}$ as great as the part of 1 inch. See answer to 21st.

(23.) The part of 5 miles will be $\frac{1}{5}$ as great as the part of 1 mile. See 20th.

(24.) See 18th.

(25.) The part of $3\frac{1}{2}$ acres will be $\frac{3}{7}$ as great as the part of 1 acre. See 17th.

(26.) See 19th.

(27.) Ans. $\frac{4}{15}$ as much as of 1 mile. See 16th.

87b. (5.) £$\frac{7}{1008}$ = $\frac{140}{27}$ qr.

(6.) .007s. = .336 qr. (7.) $\frac{8}{45}$ bu. = $\frac{512}{45}$ pt.

(8.) .15 pt. = .01875 gal. = $\frac{3}{160}$ gal.
(9.) $\frac{3}{7}\frac{3}{4}$ cwt. = $\frac{21}{4}$ lb. (10.) $\frac{3}{8}$ d. = £$\frac{1}{640}$
(11.) $\frac{5}{14}$ dwt. = $\frac{1}{672}$ gr. (12.) $\frac{4}{15}$ rd. = $\frac{1}{1200}$ m.
(13.) $\frac{4}{5}$ sq. rd. = $\frac{1}{360}$ A. (14.) .025 yd. = .4 na. = $\frac{2}{5}$ na.
(15.) .125 yd. = 4.5 in. = $\frac{9}{2}$ in. (16.) $\frac{15}{24}$ in. = $\frac{1}{1013760}$ m.
(17.) $\frac{8}{9}$ sq. ft. = $\frac{1}{784}\frac{1}{08}$ A. (18.) $\frac{5}{12}$ h. = $\frac{5}{105192}$ yr.
(19.) .00035 yr. = 184.086 min.
(20.) .0215 ft. = $\frac{43}{10,560,000}$ = .000,040,719 m.
(21.) .00,005 m. = .12,672 in. = $\frac{396}{31125}$ in.
(22.) What part of 8 in. are .00003 m.? Ans. $\frac{297}{12500}$.
(23.) What part of 5 m. are .45 ft? Ans. $\frac{3}{176,000}$.
(25.) What part of $4\frac{1}{2}$ A. are $\frac{3}{8}$ sq. ft.? Ans. $\frac{1}{505,360}$.

88a. (3.) £$\frac{5}{8}$ = $\frac{100}{8}$ = 11$\frac{1}{2}$s. = 11s. 1$\frac{1}{2}$d. = 11s. 1d. 1$\frac{1}{2}$qr.
(4.) .67 lb. = 8.04 oz. = 8 oz. .8 dwt. = 8 oz. 0 dwt. 19.2 gr.; $\frac{5}{9}$ oz. = 11$\frac{1}{9}$ dwt. = 11 dwt. 2$\frac{2}{3}$ gr.
(5.) $\frac{3}{8}$ lb. = 4$\frac{1}{2}$ ʒ. = 4 ʒ. 4 ʒ.; .14 ʒ. = 1.12 ʒ. = 1 ʒ. .36 ϑ. = 1 ʒ. 0 ϑ. 7.2 gr.
(6.) $\frac{3}{7}$ ton = 8$\frac{4}{7}$ cwt. = 8 cwt. 2$\frac{3}{7}$ qr. = 8 cwt. 2 qr. 8 lb.; .875 qr. = 24.5 lb. = 24 lb. 8 oz.; $\frac{3}{16}$ lb. = 2$\frac{10}{16}$ oz. = 2 oz. 8$\frac{8}{16}$ dr.
(7.) $\frac{3}{8}$ gal. = 1$\frac{1}{2}$ qt. = 1 qt. 1 pt.; .483 gal. = 1.932 qt. = 1 qt. 1.864 pt. = 1 qt. 1 pt. 3.456 gi.
(8.) $\frac{5}{12}$ fur. = 16$\frac{3}{4}$ rd. = 16 rd. 3$\frac{3}{4}$ yd. = 16 rd. 3 yd. 2 ft.; .35 rd. = 1.925 yd. = 1 yd. 2.775 ft. = 1 yd. 2 ft. 9.3 in.
(9 & 10.) See Art. 78, rule.
(11.) £.1456 = 2.912s. = 2s. 10.944d. = 2s. 10d. 3.776 qr.; .5716s. = 6.8592d. = 6d. 3.4368qr. .1847 sq. yd. = 1.6623 sq. ft. = 1 sq. ft. 95.3712 sq. in.
(12.) $\frac{15}{16}$ bu. = 2$\frac{14}{32}$ pk. = 2 pk. 4$\frac{28}{32}$ qt. = 2 pk. 4 qt. 1$\frac{17}{32}$ pt. = 2 pk. 4 qt. 1 pt. 2$\frac{22}{32}$ gi.
(13.) $\frac{3}{4}$ m. = 3$\frac{3}{7}$ fur. = 3 fur. 17$\frac{1}{7}$ rd., $\frac{1}{7}$ rd. = 2$\frac{5}{14}$ ft., and $\frac{5}{14}$ ft. = 4$\frac{2}{7}$ in.
(14.) $\frac{2}{14}$ A. = 2$\frac{1}{7}$ R., $\frac{1}{7}$ R. = 22$\frac{2}{7}$ sq. rd., $\frac{2}{7}$ sq. rd. = 25$\frac{1}{14}$ sq. yd., $\frac{12}{14}$ sq. yd. = 8$\frac{5}{14}$ sq. ft., and $\frac{5}{14}$ sq. ft. = 51$\frac{3}{7}$ sq. in.
$\frac{3}{5}$ sq. rd. = 18$\frac{3}{10}$ sq. yd., $\frac{3}{20}$ sq. yd. = 1$\frac{7}{10}$ sq. ft., $\frac{7}{20}$ sq. ft. = 50$\frac{2}{5}$ sq. in.
(15.) $\frac{3}{11}$ sq. m. = 174$\frac{6}{11}$ A., $\frac{6}{11}$ A. = 2$\frac{2}{11}$ R., $\frac{2}{11}$ R. = 7$\frac{8}{11}$ sq. rd., $\frac{8}{11}$ sq. rd. = 8$\frac{1}{4}$ sq. yd., $\frac{1}{4}$ sq. yd. = 2$\frac{1}{4}$ sq. ft., and $\frac{1}{4}$ sq. ft. = 36 sq. in.
.5816 A. = 2.3264 R. = 2 R. 13.056 sq. rd., .056 sq. rd. = 1.694 sq. yd., .694 sq. yd. = 6.246 sq. ft., and .246 sq. ft. = 35.424 sq. in.

$\frac{3}{5}$ yr. = 136$\frac{11}{32}$ da., $\frac{11}{32}$ da. = 23$\frac{1}{4}$ h., and $\frac{1}{4}$ h. = 15 min.
.1084 m. = .8672 fur. = 34.688 rd., .688 rd. = 3.784 yd., .784 yd. = 2.352 ft., and .352 ft. = 4.224 in.
.30716 C. = 2.45,728 C. ft. = 2 C. ft. 7.31,648 cu. ft.; .1516 cu. yd. = 4.0932 cu. ft. = 4 cu. ft. 161.0496 cu. in.

88b. (3.) £$\frac{4}{15}$ = 5s. 4d.; .28s. = 3d. 1.44qr.
(4.) $\frac{4}{15}$ lb. Troy = 3 oz. 4 dwt.
(5.) .45 lb. Apoth. = 5 ℥. 3 ʒ. 0 ℈. 12 gr.; $\frac{3}{11}$ ℥. = 2 ʒ. 0 ℈. 10$\frac{10}{11}$ gr.
(6.) $\frac{4}{5}$ T. = 8 cwt. 3 qr. 15 lb. 8 oz. 14$\frac{2}{5}$ dr.
(7.) .479 gal. = 1 qt. 1 pt. 3.328 gi.
(8.) .48 fur. = 19 rd. 1 yd. 0 ft. 3.6 in.; $\frac{3}{7}$ rd. = 2 yd. 1 ft. 0$\frac{6}{7}$ in.
(9 & 10.) $\$\frac{7}{8}$ = $.875; $\$\frac{4}{15}$ = $.266; $\$\frac{17}{128}$ = 132\frac{8}{16}$.
(11.) .3504 sq. yd. = 3 sq. ft. 22.1184 sq. in.
(12.) .709 bu. = 2 pk. 6 qt. 1.376 pt.
(13.) $\frac{5}{11}$ m. = 3 fur. 25 rd. 2 yd. 1 ft. 6 in.
(14.) .42 A. = 1 R. 27 sq. rd. 6 sq. yd. 64.8 sq. in.
(15.) .037 sq. m. = 23 A. 2 R. 28 sq. rd. 24 sq. yd. 1 sq. ft. 115.2 sq. in.
.307 yr. = 112 da. 3 h. 9 min. 43.2 sec.; $\frac{5}{14}$ C. = 2 C. ft. 13$\frac{5}{7}$ cu. ft.

89a. (12.) $\frac{45}{72} + \frac{24}{72} + \frac{40}{72} + 3\frac{60}{72} = 3\frac{169}{72} = 5\frac{25}{72}$.
(13.) $\frac{96}{168} + \frac{96}{168} + \frac{147}{168} + 5\frac{64}{168} = 5\frac{243}{168} = 7\frac{1}{24}$.
(14.) $3\frac{153}{306} + 5\frac{162}{306} + \frac{170}{306} + 16\frac{204}{306} = 24\frac{689}{306} = 26\frac{77}{306}$.
(15.) $54\frac{4}{32} + 9\frac{12}{32} + 17\frac{18}{32} + 4\frac{3}{32} = 84\frac{37}{32} = 85\frac{5}{32}$.
(16.) $28\frac{65}{975} + 75\frac{3}{975} + 105\frac{135}{975} = 208\frac{203}{975}$.
(18.) 3 yr. 10 h. 17 m. 8$\frac{4}{7}$ s. + 26 m. 40 s. + 25 s. + $\frac{7}{12}$ s. = 3 yr. 10 h. 44 m. 14$\frac{13}{84}$ s.
(19.) 1 pk. 5 qt. 0$\frac{3}{8}$ pt. + 2 qt. 0$\frac{4}{5}$ pt. + 1$\frac{3}{5}$ pt. = 2 pk. 0 qt. 1$\frac{1}{15}$ pt.
(20.) 18 gal. 3 qt. 1 pt. .8 gi. + 1 qt. 1 pt. 2.4 gi. + 1.36 gi. + 1.664 gi. = 19 gal. 1 qt. 1 pt. 2.224 gi.
(21.) 1 qr. 2 na. + 1$\frac{7}{8}$ na. + $\frac{5}{12}$ na. = 2 qr. 0$\frac{7}{96}$ na.
(22.) 1 qr. 5 lb. 9 oz. 9$\frac{3}{5}$ dr. + 22 lb. 6 oz. 6$\frac{2}{5}$ dr. + 5 oz. 5$\frac{1}{5}$ dr. + 12$\frac{4}{5}$ dr. = 2 qr. 0 lb. 6 oz. 2$\frac{2}{15}$ dr.
(23.) 3 fur. 17 rd. 0 yd. 2 ft. 4$\frac{2}{7}$ in. + 4 yd. 1 ft. 2$\frac{2}{5}$ in. + 6$\frac{2}{5}$ in. = 3 fur. 17 rd. 5 yd. 1 ft. 1$\frac{3}{35}$ in.
(24.) 1 R. 3 rd. 19 sq. yd. 2 sq. ft. 36 sq. in. + 1 R. 31 sq. rd. 3 sq. yd. 3 sq. ft. 36 sq. in. + 1 R. 4 sq. rd. + 3 R. 19 sq. rd. 8 sq. yd. 8 sq. ft. 84.384 sq. in. = 1 A. 3 R. 18 sq. rd. $\frac{3}{4}$ sq.

yd. 5 sq. ft. 12.384 sq. in. = 1 A. 3 R. 18 sq. rd. 1 sq. yd. 2 sq. ft. 120.384 sq. in.

89b. (12.) $\frac{3}{4} + \frac{9}{15} + \frac{6}{12} + 5\frac{7}{24} = 6\frac{11}{120}$.
(13.) $5\frac{3}{8} + 4\frac{1}{2} + 5 + 3\frac{1}{4} + 17\frac{5}{8} = 35\frac{1}{72}$.
(14.) $25\frac{1}{15} + \frac{3}{8}$ of $\frac{4}{5} + \frac{13}{25} + 25 + 16\frac{7}{30} = 67\frac{3}{25}$.
(18.) $\frac{4}{9}$ da. $+ \frac{5}{14}$ h. $+ \frac{3}{11}$ m. $+ \frac{4}{7}$ sec. = 11 h. 1 m. $42\frac{10}{77}$ s.
(19.) 7.375 bu. + .84 pk. + 3.58 qt. + 1.875 pt. = 7 bu. 2 pk. 7 qt. .475 pt.
(22.) $\frac{3}{8}$ cwt. $+ \frac{4}{9}$ qr. $+ \frac{3}{11}$ lb. $+ \frac{5}{7}$ oz. = 1 qr. 26 lo. 12 oz. $3\frac{17}{693}$ dr.
(23.) $\frac{3}{50}$ m. $+ \frac{9}{11}$ rd. $+ \frac{4}{7}$ ft. = 20 rd. 0 yd. 0 ft. $10\frac{8}{35}$ in. = 19 rd. 5 yd. 2 ft. $4\frac{8}{35}$ in.
(24.) $\frac{4}{5}$ A. + .24 R. + .016 A. $+ \frac{3}{22}$ A. = 2 R. 11 sq. rd. 12 sq. yd. 8 sq. ft. $97\frac{5}{7}$ sq. in., + 9 sq. rd. + 18 sq. yd. + 1 sq. ft. + 50.4 sq. in., + 2 sq. rd. 16 sq. yd. 8 sq. ft. 66.24 sq. in., + 21 sq. rd. 24 sq. yd. 6 sq. ft. 108 sq. in. = 3 R. 5 sq. rd. $11\frac{1}{4}$ sq. yd. 7 sq. ft. $34\frac{62}{175}$ sq. in. = 3 R. 5 sq. rd. 12 sq. yd. 2 sq. ft. $106\frac{62}{175}$ sq. in.

90a. (9.) $= \frac{5}{8} - \frac{32}{75} = \frac{375}{600} - \frac{256}{600} = \frac{119}{600}$; ... $= 5\frac{45}{285} - 2\frac{189}{285} = 3\frac{236}{285}$.
(10.) $= 3\frac{25}{175} - \frac{28}{175} = 2\frac{200}{175} - \frac{28}{175} = 2\frac{172}{175}$... $= 348\frac{184}{888} - 167\frac{368}{888} = 181\frac{144}{888}$.
(11.) $= \frac{4}{15} - \frac{1}{7} = \frac{28}{105} - \frac{15}{105} = \frac{13}{105}$.
(12.) $= 12\frac{15}{133} - 1\frac{1}{8} = 12\frac{120}{1064} - 1\frac{133}{1064} = 10\frac{1051}{1064}$.
(13.) 5s. 5d. $1\frac{9}{11}$qr. — 5d. $0\frac{4}{7}$qr. = 5s. 0d. $1\frac{13}{77}$qr.
(14.) = 3s. 4d. 3.2qr. — .52qr. = 3s. 4d. 2.68qr.
... = 1 qr. 0 lb. 12 oz. 8.704 dr. — 5 oz. 10.624 dr. = 1 qr. 0 lb. 6 oz. 14.08 dr.
(15.) $100 - 25\frac{9}{11} = 99\frac{11}{11} - 25\frac{9}{11} = 74\frac{32}{11}$; ... $100 - 18\frac{11}{15} = 99\frac{15}{15} - 18\frac{11}{15} = 81\frac{4}{15}$.
(16.) = 5 fur. 28 rd. 3 yd. 0 ft. $5\frac{1}{2}$ in. — 2 ft. $1\frac{5}{7}$ in. = 5 fur. 28 rd. 2 yd. 1 ft. $3\frac{3}{7}$ in.
(17.) = 2 da. 13 h. 5 min. $27\frac{3}{11}$ sec. — $21\frac{8}{11}$ sec. = 2 da. 13 h. 5 min. $5\frac{5}{11}$ sec.

90b. (9.) $9\frac{5}{6} - 4\frac{3}{4} = 5\frac{1}{12}$; $25\frac{3}{4} - 5\frac{5}{6} = 19\frac{11}{12}$; $36\frac{5}{16} - 15\frac{5}{24} = 21\frac{5}{72}$; $185\frac{5}{24} - 28\frac{5}{16} = 156\frac{13}{24}$.
(11.) $\frac{5}{8}$ of $\frac{12}{25}$ of $\frac{24}{3} - \frac{3}{5}$ of $\frac{15}{24}$ of $8\frac{3}{5} = 5\frac{23}{45} - 3\frac{9}{40} = 2\frac{103}{360}$.
(12.) $\frac{5}{21}$ of $\frac{14}{15}$ of $12\frac{1}{2} - \frac{6}{7}$ of $\frac{8}{9} = 1\frac{2}{3} - \frac{16}{21} = \frac{19}{21}$.

(13.) £.47 — .78s. = 8s. 7d. 1.76qr.
(14.) $\frac{8}{17}$ cwt. — $\frac{5}{8}$ lb. = 1 qr. 24 lb. 2 oz. $6\frac{74}{153}$ dr.
(15.) 1000 — $274\frac{3}{17}$ = $725\frac{14}{17}$; 85 — $27\frac{8}{83}$ = $57\frac{58}{83}$.
(16.) $\frac{4}{15}$ m. — $\frac{4}{15}$ rd. = 2 fur. 5 rd. 0 yd. 1 ft. $1\frac{1}{5}$ in.
(17.) .28 wk. — .308 da. = 1 da. 15 h. 38 m. 52.8 sec.

91a. (14.) $\frac{1575}{5000} \times \frac{3}{8} \times \frac{4}{9} \times \frac{8}{11} = \frac{21}{550}$. Cancel before multiplying.
(15.) $\frac{3}{4} \times \frac{5}{9} \times \frac{307}{100} \times \frac{15008}{10000} = \frac{14}{7} \frac{3888}{500} = 19\frac{1483}{7500}$.

91b. (6.) $45 \times 15\frac{1}{5} \times 8\frac{3}{4} = 5985 \ldots \frac{3}{16} \times 5\frac{5}{7} \times 4\frac{1}{12} = \frac{35}{8} = 4\frac{3}{8}$.
(7.) . . $2\frac{3}{4}$ bu., at $\$\frac{3}{1}$, = $\$\frac{33}{16} = \$2.06\frac{1}{4}$.
(8.) . . $5\frac{7}{16}$ lb., at $20\frac{1}{2}$ cts., = $\$1.11\frac{15}{32}$.
(13.) $4\frac{7}{8} \times 6.4 \times \frac{5}{13} \times .045 = \frac{27}{50}$.
(14.) If $\frac{5}{8}$ of $\frac{12}{25}$ of 1 acre . . \$32. . . \$10.50? Ans. $\frac{21}{160}$ A.

92a. (7.) $\frac{37}{8} \times \frac{7}{26} = \frac{259}{208} = 1\frac{51}{208}$.
(11.) $\frac{7}{8} \times \frac{11}{2} \times \frac{2}{15} \times \frac{2}{4} \times \frac{1}{15} \times \frac{119}{8} = \frac{2163}{6400} = 1\frac{2763}{6400}$.

92b. (5.) $4\frac{8}{9} \div 3\frac{7}{9} = \frac{22}{17} = 1\frac{5}{17} \ldots 25\frac{3}{8} \div \frac{1}{16} = 406 \ldots 7\frac{1}{8} \div \frac{3}{4} = 9\frac{1}{2}$.
(10.) $\frac{\frac{5}{7}}{10\frac{8}{15}} = \frac{75}{1106}$. . $\frac{42}{\frac{4}{7}} = \frac{147}{2} = 73\frac{1}{2}$. . $\frac{\frac{5}{8}}{3\frac{1}{8}} = \frac{8}{45}$.

93b. (2.) 415081 ft. = 25156 rd. 7 ft.
(3.) 4178 sq. yd. = 138 sq. rd. 3 sq. yd. 4 sq. ft. 72 sq. in.
(4.) 8717 in. = 3874 na. $\frac{1}{2}$ in.
(6.) 202,889 sq. ft. = 745 sq. rd. $62\frac{3}{4}$ sq. ft.
(7.) 85,165 ÷ $5\frac{1}{8}$ = 15,642$\frac{27}{41}$. 501,647 ÷ $1001\frac{4}{15}$ = 501 $\frac{186}{15019}$.

94a. (16.) $15\frac{15}{48} + 24\frac{10}{48} = 40\frac{7}{48}$; $24\frac{10}{48} - 15\frac{15}{48} = 23\frac{58}{48} - 15\frac{15}{48} = 8\frac{13}{48}$.
(17.) $2\frac{1}{16} + 10\frac{11}{14} = 2\frac{7}{112} + 10\frac{88}{112} = 12\frac{95}{112}$; $10\frac{88}{112} - 2\frac{7}{112} = 8\frac{81}{112}$.
(18.) $\frac{7}{20} + \frac{3}{14} = \frac{49}{140} + \frac{30}{140} = \frac{79}{140}$; $\frac{49}{140} - \frac{30}{140} = \frac{19}{140}$.
(19.) $\frac{29}{4} \times \frac{43}{5} = 16\frac{77}{20} = 83\frac{17}{20}$; $\frac{102}{7} \times \frac{348}{37} = \frac{37932}{259} = 146\frac{118}{259}$; $\frac{182}{49} \times \frac{79}{5} = 15\frac{1683}{245} = 61\frac{223}{245}$.
(20.) 1 qr. 20 lb. + 7 oz. $1\frac{7}{8}$ dr. + $9\frac{3}{5}$ dr. + $\frac{5}{8}$ dr. = 1 qr. 20 lb. 7 oz. $11\frac{14}{15}$ dr.
(21.) 15 gal. 1 qt. 1 pt. + 3 qt. 1 pt. $0\frac{4}{5}$ gi. + $2\frac{1}{2}$ gi. = 16 gal. 1 qt. 0 pt. $3\frac{3}{10}$ gi.

(22.) $\frac{77}{8} \times \frac{9}{25} = \frac{693}{200} = 2\frac{193}{200}$; $\frac{53}{8} \times \frac{7}{108} = \frac{371}{864}$.

(23.) $\frac{293}{7} \times \frac{9}{478} = \frac{2637}{3346}$; $\frac{5}{24} \times \frac{8}{39} = \frac{5}{117}$.

(24.) $\frac{3}{1} \times \frac{8}{33} \times \frac{8}{33} \times \frac{2}{1} = \frac{64}{121}$; $\frac{35}{2} \times \frac{3}{16} \times \frac{8}{71} \times \frac{93}{4} = \frac{8715}{1136} = 8\frac{677}{1136}$.

(25.) $\frac{7}{2} \times \frac{8}{7} \times \frac{17}{4} \times \frac{9}{11} = \frac{153}{11} = 13\frac{10}{11}$; $\frac{35}{4} \times \frac{2}{1} \times \frac{3}{7} \times \frac{4}{21} = \frac{10}{7} = 1\frac{3}{7}$.

(26.) $4\frac{525}{840} + \frac{252}{840} + 5\frac{490}{840} + (\frac{2}{7} = \frac{240}{840}) + (\frac{1}{12} = \frac{70}{840}) = 9\frac{887}{840} = 10\frac{287}{840}$.

(27.) $3\frac{5}{6} + 1\frac{1}{10} + 11\frac{2}{5} + 4\frac{73}{128} = 3\frac{1600}{1920} + 1\frac{192}{1920} + 11\frac{768}{1920} + 4\frac{1095}{1920} = 19\frac{3655}{1920} = 20\frac{347}{384}$.

(28.) $23\frac{3}{14}$ cts. $\times 204\frac{1}{2} = \frac{325}{14} \times \frac{409}{2} = \$\frac{132825}{28} = \$47.47\frac{9}{28} = \$47.473\frac{3}{14}$.

(29.) $\$12\frac{1}{2} \times 1\frac{5}{16} = \frac{25}{2} \times \frac{21}{16} = \frac{525}{32} = \$16\frac{13}{32} = \$16.406\frac{1}{4}$.

(30.) $\$47\frac{1}{8} \times 4\frac{19}{128} = \frac{39}{8} \times \frac{531}{128} = \frac{20709}{1024} = \$20.223\frac{81}{128}$.

(31.) $6\frac{47}{160} \times 75\frac{3}{8} = \frac{1007}{160} \times \frac{603}{8} = \frac{607221}{1280} = \$474.391\frac{13}{32}$.

(32.) $£1\frac{1}{8} \times 3\frac{7}{8} = £\frac{9}{8} \times \frac{31}{8} = £\frac{279}{64} = £4\frac{23}{64} = £4$ 7s. 2d. 1qr.

(34.) $\$12.5 \times 1.3125 = \$16.40625$.

(35.) $\$4.875 \times 4.1484+ = \$20.2235—$.

(36.) $\$75.375 \times 6.29375 = \$474.3914+$.

(37.) $£1.125 \times 3.875 = £4.359375 = £4$ 7s. 2d. 1qr.

(40.) $3\frac{1}{4} \times 3 = 9\frac{3}{4}$; or $3.25 \times 3 = 9.75$ sq. ft.

(41.) $15\frac{1}{2} \times 12\frac{1}{4} \div 9\frac{3}{4} = \frac{31}{2} \times \frac{49}{4} \times \frac{4}{39} = 19\frac{37}{78}$ yd.; or, $15.5 \times 12.25 \div 9.75 = 189.875 \div 9.75 = 19.47436$.

(42.) $1\frac{6}{12} \times 27 = 38\frac{1}{4}$ sq. ft.; $(15\frac{1}{2} + 12\frac{1}{4})\ 2 = 55\frac{1}{2}$ feet, the distance round the room, and $55\frac{1}{2} \times 8\frac{1}{2} = \frac{111}{2} \times \frac{17}{2} = \frac{1887}{4} = 471\frac{3}{4}$ sq. ft. in the room. $471\frac{3}{4} - 140 = 331\frac{3}{4}$ sq. ft. to be covered by the paper, and $331\frac{3}{4} \div 38\frac{1}{4} = \frac{1327}{4} \div \frac{153}{4} = 8\frac{103}{153}$ rolls.

(43.) $40\frac{5}{9}$ m. $= 214{,}133\frac{1}{3}$ ft.; $214{,}133\frac{1}{3} \div 15\frac{3}{5} = \frac{642400}{3} \times \frac{5}{78} = 13{,}726\frac{58}{117}$.

(44.) $43\frac{5}{7}$ gal. $= 349\frac{5}{7}$ pt.; $349\frac{5}{7} \div 1\frac{3}{4} = \frac{2448}{7} \times \frac{4}{7} = 199\frac{41}{49}$.

(45.) $\frac{3}{8} \times 75\frac{1}{2} \div \frac{5}{8} = \frac{3}{8} \times \frac{151}{2} \times \frac{8}{5} = \frac{453}{10} = 45\frac{3}{10}$ bu.; or, $.375 \times 75.5 = \$28.3125$, and $28.3125 \div .625 = 45.3$ bu.

(46.) $\frac{383}{8} \times \frac{129}{4} \times \frac{1}{160} = \frac{46827}{5120} = 9\frac{747}{5120}$ A., and $9\frac{747}{5120} \times 25 = \$228.647\frac{59}{128}$. Or, $45.375 \times 32.25 \div 160 = 1463.34375 \div 160 = 9.1459—$ A. $= \$228.6475$.

(47.) $10\frac{5}{8} \div \frac{3}{8}$ of $25\frac{1}{2} = \frac{85}{8} \times \frac{8}{3} \times \frac{2}{51} = \frac{170}{153} = \$1\frac{17}{153}$; and $\frac{170}{153} \times \frac{61}{8} = \frac{5185}{612} = \$8\frac{289}{612}$.

(48.) 7 lb. $= \frac{1}{28}$ of 1 bbl.; $\frac{1}{28}$ of $\$57\frac{1}{8}$ = the ans.

(49.) $8\frac{1}{2} \times 3\frac{1}{3} \times 2\frac{3}{4} = \frac{33}{4} \times \frac{10}{3} \times \frac{11}{4} = \frac{605}{8} = 75\frac{5}{8}$ cu. ft., and $75\frac{5}{8} \times \frac{4}{5} \times \frac{8}{9} = \frac{2400}{360} = 60\frac{240}{360}$.

(52.) $129\frac{3}{4} \times 956 = 124{,}041$ sq. ft. $= 13{,}782$ sq. yd. 3 sq. ft. $= 455$ sq. rd. $18\frac{1}{4}$ sq. yd. 3 sq. ft. $= 2$ A. 3 R. 15 sq. rd. 18 sq. yd. 5 sq. ft. 36 sq. in.

(53.) $= 5410$ yd. 2 ft. $= 983$ rd. $3\frac{1}{2}$ yd., &c. $= 24$ fur. 23 rd., &c. $= 3$ m. 23 rd. $3\frac{1}{2}$ yd. 2 ft. $=$ ans.

(54.) $= 50{,}654$ ft. 10 in. $= 16{,}884$ yd. 2 ft., &c. $= 3069$ rd. $4\frac{1}{2}$ yd., &c. $= 76$ fur. 29 rd., &c. $= 9$ mi. 4 fur. 29 rd. $4\frac{1}{2}$ yd. 2 ft. 10 in. $=$ ans.

(55.) . . . $29\frac{3}{4}$ sq. yd. 4 sq. ft. $= 30$ sq. yd. 1 sq. ft. 108 sq. in.; $29\frac{1}{2}$ sq. yd. 6 sq. ft. $= 30$ sq. yd. 1 sq. ft. 72 sq. in.

(56.) $\frac{1}{4}$ A. $= 2\frac{2}{7}$ R., $\frac{2}{7}$ R. $= 11\frac{1}{7}$ sq. rd., $\frac{3}{7}$ sq. rd. $= 12\frac{3}{28}$ sq. yd., $\frac{27}{28}$ sq. yd. $= 8\frac{18}{28}$ sq. ft., $\frac{18}{28}$ sq. ft. $= 97\frac{1}{2}$ sq. in.

(59.) .27 rd. $= 1.485$ yd., .485 yd. $= 1.455$ ft., .455 ft. $=$ 5.46 in.

(60.) 1 sq. rd. $15\frac{3}{4}$ sq. yd. 1.4766 sq. ft. and $\frac{3}{4}$ sq. yd. $=$ 6.75 sq. ft., which added to 1.4766 sq. ft. $= 8.2266$ sq. ft.

(62.) .0866 sq. rd. $= 2.61965$ sq. yd., 61965 sq. yd. $=$ 5.57685 sq. ft.

94b. (13.) . . . $\frac{47}{24}\frac{85}{8} = 199\frac{3}{8}$; $\frac{4.86}{10.500}\frac{1.918}{} = 120\frac{959}{2025}$.

(14.) . . $\frac{81804}{750} = 1088.06$; $\frac{7853.613}{10} = 15{,}700.2708+$.

(15.) . . $4\frac{5}{16}$ and $25\frac{11}{24}$? Ans. Sum, $30\frac{19}{48}$, diff. $20\frac{29}{48}$.

(19.) . . $25\frac{3}{15} \times 1\frac{4}{15} = \frac{718}{225} = 31\frac{207}{225}$; $374\frac{1}{12} \times 1\frac{1}{23} = \frac{8978}{276} = 390\frac{98}{276}$.

(20.) Add $\frac{1}{5}$ cwt. $\frac{3}{7}$ lb. and $\frac{5}{8}$ oz. $= 3$ qr. 6 lb. 1 oz. $0\frac{64}{315}$ dr.

(22.) $4\frac{8}{9} \div 25\frac{5}{18} = \frac{88}{455}$. . . ; $\frac{3}{8}$ of $\frac{16}{21} \div \frac{1}{28}$ of $5\frac{1}{4} = \frac{32}{21} = 1\frac{11}{21}$.

(24.) $\frac{5}{4\frac{5}{8}} \div \frac{3\frac{5}{7}}{8\frac{4}{5}} = \frac{1386}{533} = 2\frac{320}{533}$. $\frac{\frac{7}{8}}{\frac{4}{5}} \div \frac{\frac{3}{5}}{\frac{5}{16}} = \frac{1225}{1536}$.

(25.) $\frac{5\frac{3}{8}}{27} \times \frac{24\frac{3}{8}}{\frac{4}{5}} = \frac{325}{54} = 6\frac{1}{54}$.

(26.) $4\frac{3}{7} + \frac{4}{5}$ of $3\frac{5}{8} + 15\frac{15}{28} + \frac{8}{35} = 23\frac{13}{140}$.

(27.) $5\frac{4}{9} + \frac{6\frac{1}{2}}{5\frac{3}{4}} + 7.25 = 13\frac{683}{828}$.

(28.) . . 47 gal. 1 qt. . . at $\$0.42\frac{1}{8}$ per gal.?
Ans. $\$19.904\frac{1}{16}$.

(29.) . . 3 lb. 5 oz. 16 dwt. . . $\$13.25$ per lb.?
Ans. $\$\frac{11077}{240} = \$46.154\frac{1}{6}$.

(30.) . . 3 C. 7 C. ft. 15 cu. ft. . . at $\$3\frac{3}{4}$ per C.?
Ans. $\$\frac{7665}{512} = \$14.97\frac{8}{128}$.

(31.) . . 1 A. 1 R. 15 sq. rd. . . at $47\frac{1}{4}$ per A. ?
Ans. $\$1\frac{9}{10}\frac{7}{8}\frac{7}{0} = \$64.231\frac{1}{4}$.

(32.) . . 1 yd. 1 qr. 1 na. . . at 18s. 6d. per yd. ?
Ans. $£\frac{7}{6}\frac{7}{4}\frac{7}{0} = £1$ 4s. 3d. $1\frac{1}{2}$qr.

(39.) . . 18 ft. 5 in. long, and 19 in. wide . . at $2\frac{3}{4}$ cts. ?
Ans. $\$.801\frac{2}{2}\frac{5}{8}\frac{7}{8}$.

(40 & 41.) . . room $20\frac{1}{2}$ ft. long, 15 ft. 9 in. wide . . carpeting 3 ft. 4 in. wide, at $\$2.37\frac{1}{2}$ per yd. ? Ans. $\$76.682\frac{3}{16}$.

(42.) . . Paper $1\frac{7}{12}$ ft. wide, 25 ft. long, room $20\frac{1}{2}$ ft. by 15 ft. 9 in., walls 9 ft. high, deduct 165 sq. ft. for doors, &c. ?
Ans. $39\frac{7}{12}$ sq. ft. per roll ; $12\frac{6}{19}$ rolls.

(43.) . . wheel $12\frac{3}{8}$ ft. in going $153\frac{4}{15}$ miles ?
Ans. $65,393\frac{7}{8}$ times.

(44.) . . . $1\frac{3}{8}$ qt. . . . 178 gal. ? Ans. 445 bottles.

(45.) . . $\$\frac{7}{8}$ per bu. . . $38\frac{1}{4}$ gal. at $\$\frac{5}{16}$ per gal. ?
Ans. $13\frac{3}{5}\frac{1}{6}$ bu.

(46.) . . $38\frac{4}{5}$ rd. long, $24\frac{7}{8}$ rd. wide . . at $30 per A ?
Ans. $\$180.965\frac{5}{8}$.

(47.) If $\frac{7}{4}$ of $36\frac{1}{2}$ bu. . . $\$8\frac{3}{8}$, . . 1 bu. ? $5\frac{1}{3}$ bu. ?
Ans. $\$.803\frac{6}{7}\frac{3}{3}$; $\$4.372\frac{2}{8}\frac{2}{5}\frac{1}{7}$.

(48.) . . $6\frac{1}{8}$. . 14 lb. . . to gain $\$\frac{3}{4}$ per bbl. ?
Ans. $\$.464\frac{2}{7}$?

(49.) . . chest 5 ft. 6 in. long, 3 ft. 2 in. wide, 2 ft. 6 in. high ? Ans. $43\frac{1}{2}\frac{3}{4}$ cu. ft. ; $34\frac{4}{4}\frac{4}{8}\frac{3}{5}$ bu.

(50.) . . 12 ft. 6 in. long, 3 ft. 10 in. wide, 6 ft. 3 in. high, $\$5\frac{1}{4}$? Ans. $299\frac{2}{4}\frac{3}{8}$ cu. ft. ; $2\frac{2}{6}\frac{0}{1}\frac{8}{4}\frac{7}{4}$ C. ; $\$12.283\frac{3}{10}\frac{3}{2}\frac{3}{4}$.

(51.) . . 21 rd. 10 ft. long, 17 rd. 13 ft. wide ?
Ans. 104,632.75 sq ft. = 2 A. 1 R. 24 sq. rd. 9 sq. yd. 7 sq. ft. 108 sq. in.

(54.) . . . 1,000,000 in. to miles, &c. ?
Ans. 15 m. 6 fur. 10 rd. 2 yd. 2 ft. 4 in.

(56.) $\frac{2}{1}\frac{3}{1}$ A. = 1 R. 3 sq. rd. 19 sq. yd. 2 sq. ft. 36 sq. in.

(57.) 2 m. 3 fur. 5 yd. 1 ft. 7 in. × 5 = 11 m. 7 fur. 4 rd. 5 yd. 1 ft. 11 in.

(58.) 3 A. 25 sq. rd. 12 sq. yd. × 7 = 22 A. 0 R. 17 sq. rd. 23 sq. yd. 4 sq. ft. 72 sq. in.

(60.) 3108.018 sq. ft. = 11 sq. rd. 12 sq. yd. 5 sq. ft. 38.592 sq. in.

(63.) 1409.015 cu. ft. = 52 cu. yd. 5 cu. ft. 25.92 cu. in. ?

95a. (18.) 10 bbls. will cost $\frac{1}{17}$ as much as 17 bbls.; 19 bbls., $\frac{1}{17}$ as much; $30\frac{1}{2}$ bbls., $\frac{6}{34}$ as much, &c.; $\frac{1}{17}$ of \$60.35 = \$3.55, $\frac{1}{17}$ = \$35.50; $\frac{2}{17}$ = \$67.45, &c.

(19.) $\frac{1}{35}$ of 24 min. = $12\frac{2}{35}$ min.

(20.) It will take 8 men $\frac{1}{8}$ of 8 days; 12 men, $\frac{1}{12}$ = $\frac{1}{8}$ of 8 days, &c. It will take 8 times 10 men to do it in 1 day; $\frac{8}{5}$ of 10 men to do it in 5 days, &c.

(23.) 1 ton will cost $\frac{1}{4}$ of \$44, $\frac{1}{8}$ of a ton will cost $\frac{1}{8}$ of $\frac{1}{4}$ of \$44 = \$$\frac{44}{32}$ = \$$3\frac{1}{4}$.

(24.) $\frac{4}{7}$ of $\frac{1}{8}$ of \$$\frac{21}{4}$ = \$$\frac{45}{8}$ = \$$5\frac{5}{8}$.

(25.) $\frac{17}{8}$ of $\frac{1}{8}$ of \$$\frac{178}{1}$ = \$$50.45\frac{23}{256}$; $\frac{201}{8}$ of $\frac{1}{8}$ of \$$\frac{178}{1}$ = \$$79.86\frac{17}{256}$.

(26.) One tub will cost $\frac{1}{3}$ of \$$5\frac{3}{4}$, and 3 tubs will cost 3 times $\frac{16}{3}$ or 16 times \$$5\frac{3}{4}$ = \$92; $8\frac{3}{4}$ tubs = $\frac{35}{4}$ of $\frac{16}{3}$ of \$$\frac{23}{4}$ = \$$268.33\frac{1}{3}$.

(27.) $\frac{1}{2}$ of $\frac{1}{3}$ of \$$\frac{165}{8}$ = \$$\frac{825}{16}$ = \$$51.56\frac{1}{4}$; $\frac{7}{7}$ of $\frac{1}{3}$ of \$$\frac{165}{8}$ = \$$\frac{1155}{56}$ = \$$73.66\frac{1}{14}$. If $\frac{165}{8}$ of \$1 will furnish them 3 wks., $\frac{1}{8}$ of a dollar will furnish them $\frac{1}{165}$ of 3 wks. = $\frac{1}{55}$ wk., and \$1 will furnish them 8 times $\frac{1}{55}$ wk., &c.

(28.) $\frac{1}{6}$ of \$1 will pay for $\frac{1}{25}$ of 5 rods; therefore \$1 will pay for $\frac{6}{25}$ of 5 rods; and \$$15\frac{1}{8}$ will pay for $\frac{121}{8}$ of $\frac{6}{25}$ of 5 rods = $\frac{2652}{200}$ = $18\frac{3}{70}$ rods.

(29.) Since $\frac{1}{45}$ of 1 bu. of potatoes will pay for $\frac{1}{6}$ of 1 bu. of corn, it will take $\frac{6}{45}$ = $\frac{1}{9}$ of 1 bu. of potatoes to pay for 1 bu. of corn, and 35 times $\frac{1}{9}$ of 1 bu. to pay for 35 bu. corn. $\frac{1}{9} \times \frac{35}{1}$ = $\frac{45}{9}$ = $50\frac{5}{9}$ bu.

(30.) If the apples were 1 ct. a bushel, $\frac{1}{40}$ lb. of tea would pay for 1 bu.; but as they are 75 cts. a bu., it will take $\frac{75}{40}$ lb. of tea to pay for 1 bu.; and 15 times $\frac{75}{40}$ lb. to pay for 15 bu., &c. $\frac{75}{40} \times 15 = \frac{2325}{80} = 28\frac{5}{8}$; $\frac{80}{40} \times 15 = 30$; $\frac{112\frac{1}{2}}{40} \times 15 = \frac{22725}{800} \times 15 = 42\frac{3}{16}$.

(31.) $\frac{2}{25}$ of $\frac{16}{3} \times \frac{231}{2} = \frac{12232}{25} = 49\frac{7}{25}$; because if the pork were \$1 a lb. it would take $\frac{16}{3}$ of a yd. of cloth to pay for 1 lb.; but as the pork is but $\frac{2}{25}$ of \$1 a lb. it will take but $\frac{2}{25}$ of $\frac{16}{3}$ of 1 yd. to pay for 1 lb. of pork.

(32.) The post that casts a shadow 1 ft. long must be $\frac{2}{15}$ as high as that which casts a shadow $7\frac{1}{2}$ ft. long. The steeple that casts a shadow 140 ft. long must be 140 times $\frac{2}{15}$ of $6\frac{1}{2}$ ft. = $121\frac{1}{3}$. Or, since the post is $\frac{2}{15}$ as long as its shadow, the spire must be $\frac{2}{15}$ as long as *its* shadow; $\frac{2}{15}$ of 140 ft. = $121\frac{1}{3}$ ft., &c.

(33.) To do it in 1 da. it would take 18 times 8 men, and to do it in 12 da. it will take $\frac{1}{12}$ of 18 times 8 men, or $\frac{1}{12} = \frac{3}{2}$ of 8 men = 12 men; to do it in 24 da. $\frac{1}{24}$ of 8 men = 6 men, &c.

(34.) $\frac{5}{8}$ of it = 45 cts.; he has spent $\frac{1}{4} + \frac{3}{8} + \frac{2}{3} = \frac{23}{24}$; there remains $\frac{1}{24}$ of the whole = 11 cts.

(35.) He has spent $\frac{1}{8} + \frac{5}{12} + \frac{1}{6} + \frac{5}{24} = \frac{22}{24} = \frac{11}{12}$; 20 cts. must therefore be $\frac{1}{12}$ of his money.

(36.) $\frac{3}{10} + \frac{5}{6}$ of $\frac{3}{10} + \frac{3}{5}$ of $\frac{3}{10} = \frac{3}{10} + \frac{1}{4} + \frac{4}{15} = \frac{49}{60}$. The remaining 22 must be $\frac{11}{60}$ of the whole.

(37.) $\frac{3}{8} + \frac{2}{7} + \frac{3}{4} = \frac{79}{56}$. 79 is $\frac{79}{56}$ of 56

(38.) $\frac{3}{8} + \frac{5}{6}$ of $\frac{3}{8} + \frac{1}{4}$ of $\frac{3}{8}$ of $\frac{3}{8} + \frac{5}{4}$ of $\frac{3}{8}$ of $\frac{3}{8} = \frac{3}{8} + \frac{1}{8} + \frac{1}{24} + \frac{5}{24} = \frac{19}{24}$. 30 is therefore $\frac{5}{24}$ of the whole.

95b. (18.) If 25 bbls. cost \$106.25 . . . $15\frac{3}{4}$ bbls. ?
Ans. \$66.93¾.

(19.) . . . 25 gal. in 10 min. . . . 34 gal. ?
Ans. $13\frac{3}{5}$ min.

(23.) If $\frac{3}{5}$ ton cost \$2$\frac{1}{7}$, . . . $\frac{5}{12}$ ton ? Ans. \$2.38$\frac{2}{21}$.

(24.) If 15 yds. cost \$32$\frac{1}{8}$, . . . $5\frac{4}{5}$ yds. ?
Ans. \$11.66$\frac{1}{14}$

(26.) If $\frac{5}{18}$ tub cost \$47$\frac{1}{8}$, ... $5\frac{1}{4}$ tubs ?
Ans. \$92.137½.

(27.) If \$30$\frac{3}{4}$. . 10 men 5 wks., . . . $8\frac{3}{7}$ wks. ?
Ans. \$51.835$\frac{5}{7}$.

How long will \$25$\frac{1}{8}$ furnish them ? Ans. $4\frac{7}{27}$ wks.

(28.) If \$3$\frac{3}{8}$. . . 8 rods, . . . \$23$\frac{1}{4}$? Ans. $55\frac{1}{3}$ rd.

(30.) . . . tea at 45 cts. . . . 22 bu. at 87½ cts. ?
Ans. $42\frac{7}{9}$ lb.

(31.) . . at \$$\frac{3}{8}$. . 275$\frac{3}{4}$ lb. at \$$\frac{3}{32}$ per lb. ?
Ans. $68\frac{1}{16}$ yds.

(32.) . . $7\frac{3}{4}$ ft. high . . shadow, $5\frac{1}{4}$ ft. . . spire, whose shadow is $75\frac{3}{8}$ ft. ? Ans. $111\frac{15}{16}$ ft.

(34.) . . 84 cts. . . spent $\frac{1}{5}$ of $\frac{5}{12}$ of $\frac{5}{7}$ of it; how much remains ? Ans. \$.79.

(35.) . . $\frac{1}{12}$, $\frac{5}{18}$, $\frac{1}{9}$, $\frac{1}{15}$. . \$1.66 left . . ?
Ans. \$3.60; 30 cts., \$1, 40 cts., 24 cts.

(36.) . . $\frac{3}{8}$, $\frac{3}{4}$ as many, $\frac{3}{5}$ as many, remaining 19 . . . ?
Ans. 160 scholars.

(37.) . . $\frac{3}{8} + \frac{2}{5} + \frac{5}{12} = 143$. . ? Ans. 120.

(38.) . . $\frac{7}{18}$ apples, $\frac{2}{7}$ as many cherries, $\frac{1}{10}$ as many quinces as cherries, 5 times as many peaches as quinces, the remaining 20 pears . . . ? Ans. 320 trees; 140, 100, 10, 50.

97b. (2.) 175 a product, one factor $27\frac{3}{8}$? Ans. $6\frac{3\,8}{2\,1\,9}$.
(3.) $372\frac{1}{8}$ a product, one factor 25? Ans. $14\frac{1\,7\,7}{2\,0\,0}$.
(6.) $28 + 35$ a product, one factor 7? Ans. $4 + 5$.
(7.) $(5 \times 9) + (9 \times 2)$ a product, one factor 9?
Ans. $5 + 2$.
(9.) $8^2 + \overline{8 \times 7} + 8^3$ a product, one factor 8?
Ans. $8 + 7 + 8^2$.
(10.) $(5^2 \times 4 \times 8) + (5 \times 4 \times 8^2) + 8^2$ a product, one factor 8? Ans. $(5^2 \times 4) + (5 \times 4 \times 8) + 8$.

99a. (6.) 9 yards $\frac{7}{8}$ wide contain $7\frac{7}{8}$ sq. yards; $7\frac{7}{8} \div \frac{3}{8} = \frac{6\,3}{8} \times \frac{8}{3} = 21$ yards.
(7.) $\frac{3\frac{1}{2} \times 144}{18\frac{1}{2}} = \frac{1008}{37} = 27\frac{9}{37}$; $\frac{5\frac{1}{2} \times 144}{18\frac{1}{2}} = \frac{1584}{37} = 42\frac{3\,0}{3\,7}$; $\frac{28\frac{3}{4} \times 144}{18\frac{1}{2}} = \frac{8280}{37} = 223\frac{2\,9}{3\,7}$.
(8.) $\frac{2\frac{1}{2} \times 160}{12} = 33\frac{1}{3}$; $\frac{2\frac{1}{2} \times 160}{15\frac{3}{4}} = \frac{1600}{63} = 25\frac{2\,5}{6\,3}$; $\frac{3200}{145} = 22\frac{8}{2\,9}$.
(9.) $85\frac{3}{4} \div 45\frac{1}{6} = \frac{3\,4\,3}{4} \times \frac{6}{3\,6\,1} = \frac{6\,8\,6}{3\,6\,1} = 1\frac{3\,2\,5}{3\,6\,1}$.
(10.) $\frac{48\frac{1}{8}}{2} + \frac{22\frac{1}{4}}{2} = 24\frac{1}{16} + 11\frac{1}{8} = 35\frac{3}{16}$, and $24\frac{1}{16} - 11\frac{1}{8} = 23\frac{17}{16} - 11\frac{2}{16} = 12\frac{1\,5}{1\,6}$.
(11.) $\frac{85\frac{7}{8}}{2} + \frac{33\frac{3}{4}}{2} = 42\frac{15}{16} + 16\frac{7}{8} = 59\frac{1\,3}{1\,6}$, and $42\frac{15}{16} - 16\frac{7}{8} = 26\frac{1}{16}$.
$\frac{48\frac{5}{6}}{2} + \frac{17\frac{5}{14}}{2} = 24\frac{5}{12} + 8\frac{19}{28} = 24\frac{35}{84} + 8\frac{57}{84} = 33\frac{2}{21}$, and $24\frac{35}{84} + 8\frac{57}{84} = 23\frac{119}{84} - 8\frac{57}{84} = 15\frac{31}{42}$.
(13.) $\frac{5\frac{1}{2} \times 128}{5 \times 4} = \frac{176}{5} = 35\frac{1}{5}$.

99b. (6.) . . . $1\frac{3}{8}$ wide . . . $7\frac{1}{2}$ yds. . . $\frac{5}{8}$ wide? How much that is $1\frac{1}{3}$ wide? Ans. $3\frac{9}{22}$ yd.; $4\frac{1}{6}$ yd.
(7.) . . $15\frac{1}{4}$ in. wide, . . . $25\frac{3}{8}$ sq. ft.?
Ans. 19 ft. $11\frac{37}{61}$ in.
(8.) . . . $47\frac{1}{8}$ A. . . . $23\frac{1}{8}$ rods wide? Ans. $33\frac{37}{37}$.
(9.) Dividend $351\frac{8}{15}$, quotient $22\frac{3}{5}$? Ans. Divisor $15\frac{5\,2\,4}{1\,0\,1\,5}$.
(10.) Sum $35\frac{3}{8}$, difference $14\frac{5}{12}$?
Ans. $24\frac{4\,3}{4\,8}$ and $10\frac{2\,3}{4\,8}$.
(12.) . . content $418\frac{1}{2}$ cu. ft., $9\frac{1}{2}$ ft. long, $7\frac{1}{2}$ ft. wide?
Ans. $5\frac{3\,3}{5\,5}$ deep.

(13.) . . . 16½ C. 3⅝ ft. wide, 6 ft. high?
Ans. 98$\frac{12}{145}$ ft. long.

100a. (5.)

½) 3.25	price of 1 yd.		
3			
9.75	"	3 yds.	
½) 1.625	"	2 qr.	
½) .812½	"	1 qr.	
.406¼	"	2 na.	
$12.593¾	"	3 yd. 3 qr. 2 na.	

(6.)

⅕) 6.50	price of 1 ton.		
5			
32.50	"	5 tons.	
1.30	"	4 cwt.	
⅕) 1.30	"	4 cwt.	
¼) .162½	"	2 qr.	
½) .081¼	"	1 qr.	
¼) .040⅝	"	14 lb.	
.005$\frac{15}{16}$	"	2 lb.	
35.390\frac{15}{16}$	price of 5 tons [8 cwt. 3 qr. 16 lbs.		

(6.)

⅕) 6.50	price of 1 ton.		
⅕) 1.30	"	4 cwt.	
¼) .162½	"	2 qr.	
½) .040⅝	"	14 lb.	
.020$\frac{5}{16}$	"	7 lb.	
8.023\frac{7}{16}$	"	1 ton, 4 cwt. 2 qr. [21 lbs.	

(6.)

½) 6.50	price of 1 ton.		
½) 3.25	"	10 cwt.	
½0) 1.625	"	5 cwt.	
½) .081¼	"	1 qr.	
¼) .040⅝	"	14 lb.	
½) .011$\frac{7}{16}$	"	4 lb.	
.005$\frac{1}{16}$		2 lb.	
5.014\frac{3}{4}$	price of 15 cwt. [1 qr. 20 lbs.		

(7.)

$87.50	price of 1 A.		
3			
½) 262.50	"	3 A.	
⅕) 65.625	"	3 R.	
13.125	"	24 rd.	
$341.25	price of 3 A. 3 R. 24 rd.		

(7.)

¼) 87.50	price of 1 A.		
5			
437.50	"	5 A.	
⅕) 21.875	"	1 R.	
½) 5.468¾	"	10 rd.	
2.734⅜	"	5 rd.	
467.578\frac{1}{8}$	price of 5 A. [1 R. 15 rd.		

100b. (4.) . . 25 yds. . . . at £2 15s. 9¼d.
Ans. £69 15s. 3¼d.

(5.) . . 7 yd. 2 qr. 1 na. . . at $4.625?
Ans. 34.976\frac{3}{16}$.

(6.) At $5.75, . . 18 T. 5 cwt. 2 qr. 16 lb. ?
Ans. 105.122\frac{9}{16}$.

(7.) At $45 per A. . . 5 A. 3 R. 15 sq. rd. ?
Ans. 262.968\frac{3}{4}$.

101—106.

The examples in Art. 101 to 106 inclusive are so short that a solution of them here would be of little aid to the teacher in conducting the recitations of his pupils.

101b. (17.) Multiply 327,108 by 5; 12½; 25; 33⅓; 50; 99.

Ans. 1,635,540; 4,088,850; 8,177,700; 10,903,600; 16,355,400; 32,383,692.

(18.) Divide 327,108 by 5; 12½; 25; 33⅓; 50.

Ans. 65,421.6; 26,168.64; 13,084.32; 9,813.24; 6,542.16.

102b. (9.) 37 per cent. of $1041.27 = $385.2699; 18 per cent. of $314.018 = $56.52324.

(11.) 56¼ per cent. of $150.75 = $84.796875.

(12.) 62½ per cent. of 7 casks, each 135½ lb. = 592.8125 lb.

(13.) 275 per cent. of $84.15 = $231.4125.

(15.) 6¼ per cent. of $500.25 = $33.766875; ⅝ per cent. of $154.30 = $.578625.

(17.) . . $5175 . . 25⅜ per cent. ?
Ans. $1313.15625.

(18.) . . $3500 . . one gains 15 per cent. . . the other gains 6¼ per cent. ? Ans. $306.25.

(20.) . . 519 lb. at 17½ cents; . . gain 15 per cent. ?
Ans. 20⅛ cents.

(24.) $316.05 is $40.75 ? Ans. 12$\frac{5}{6}\frac{4}{3}\frac{9}{2}\frac{1}{1}$ per cent.; . . . $5 is $1.625 ? Ans. 32½ per cent.

103b. (1.) . . . 2025 bu. at $.56¼ . . . 1⅞ per cent. ?
Ans. $21.35742.

(2.) . . . 3070 gal. at $.87½ . . . 2½ per cent. ?
Ans. $60.4406.

(3.) . . 15 shares at $97¼ . . ⅛ per cent. ?
Ans. $4.8625.

(4.) . . £575 6s. 8d. . . 2⅓ per cent. ?
Ans. £13 8s. 5d. 3.46 qr.

104b. (3.) . . £500 18s. 9d. . . 1¾ per cent., . policy $1 . . . £1 = $4.87 ? Ans. $43.692+.

105b. (2.) Bought 37 shares at 2½ per cent. premium, sold at 1¼ per cent. discount ? Ans. Lost $138.75.

(3.) . . 3 shares . . 10½ per cent. premium ?
Ans. $1657.50
(4.) . . 3½ per cent. . . . 5 shares ? Ans. $87.50
(5.) . . 12 shares at 2¼ per cent. premium ?
Ans. $350.57½.

106b.

(4.) .385 per cent., i. e., 38½ cents on $100, $7,048 . . 2 polls at $1.50 ? Ans. $30.1348.

(7.) . . real estate $7.40 . . . personal do. $5.20 . . tax .45 per cent. ?
Ans. Real estate $1644.44̇; personal $1155.55̇.

107a. (2.) Gross wt. 9611 lb. — tare 1442— lb. = 8169 lb. net. Sugar, $204.225; boxes, $61.75; duty, $7.12½; weighing, &c., $6.27; other expenses, $.87½ + $1.25 + $.25; amount, $281.74½ + 2½ per cent., $7.04, = $ 88.78½, the whole cost in Cayenne, 30 per cent. of which is $86.635½.

(3.) $252.80 + com. $6.32 = $259.12; 40 per cent. of which is $103.65.

(4.) Cost $1162.50 + com. $29.06 = $1191.56; 30 per cent. of which is $357.47.

(5.) 1379.5 lb. — tare 27.6 lb. = 1352 lb., cost $23.66; 30 per cent. of which is $7.10.

(6.) Cost $16,832.53; 30 per cent. of which is $5049.76.

107b. (3.) 40 bbls. . . $380.75 . . 2½ per cent., duty 40 per cent. ? Ans. $156.1075.

(4.) 10,000 gal. . 11¾ cents . . . com. 2½ per cent., duty 30 per cent. ? Ans. $361.3125.

(5.) 200 bags . . 27,340 lb., tare 2 per cent., cost 2⅛ cents per lb., duty 30 per cent. ?
Ans. 26,793.2 lb. net; duty $170.8066+.

108a. (13.) Interest of $1 for 1 yr. 3 ms. = $.075; for 8 da. = $.001⅓; $48.17 × .076⅓ = $3.67697. Interest of $1, $.217; $48.17 × .217 = $10.452·9; $48.17 × .281⅛ = $13.559855, $48.17 × .339⅛ = $16.353715.

(14.) Time 5 yr. 10 mo. 10 da.; int. on $1, $.351⅛. Time 2 yr. 4 mo. 22 da.; int. on $1, $.143⅜. Time 4 yr. 8 mo. 19 da.; int. on $1, $.283⅛. Time 11 yr. 2 mo. 13 da.; int. on $1, $.672⅛.

(15.) Time 4 yr. 10 mo. 25 da.; int. on $1, $.294⅛; int. on $2007.81, $590.6307.

Time 17 yr. 5 mo. 26 da.; int. on $1, $1.049⅛; int. on $2007.81, $2106.86196.

Time 3 yr. 1 mo. 26 da.; int. on \$1, \$.189⅓; int. on \$2007-.81, \$380.14536.

(16.) Interest at 6 per cent., .076⅓; \$3.67698. For 5½ per cent., deduct $\frac{1}{12}$ = \$.3064; for 4½ per cent., ¼ = \$.91924; for 7 per cent. add ⅙ = \$.61283; for 7½ per cent ¼ = \$.91924; for 9 per cent., ½ = \$1.83849; for 12½ per cent., $1\frac{1}{12}$ times that at 6 per cent. = \$3.98339; for 3¼ per cent., take ½ of that at 6 per cent., and $\frac{1}{12}$ of that.

(17.) Interest at 6 per cent., \$.614687; for 6½ per cent., add $\frac{1}{12}$ = \$.051224.

Interest at 6 per cent., \$3.102708; for 7 per cent., add ⅙ = \$.517118.

Interest at 6 per cent., \$18.528437; for 6¾ per cent., add ⅛ = \$2.316055.

Interest at 6 per cent., \$7.1655; for 5¾ per cent., subtract $\frac{1}{24}$ = \$.29856.

The answers to questions 16 and 17 are carried to the nearest ten thousandth, in order to exercise the pupil in such operations. It will be a useful exercise for him to perform them again, getting the result to the nearest cent, as he would do in actual business. The answers which he should obtain in this way are inserted for the convenience of the teacher.

(16.) \$3.68 − \$.31 = \$3.37; \$3.68 − \$.92 = \$2.76; \$3.68 + \$.61 = \$4.29; \$3.68 + \$.92 = \$4.60; \$3.68 + \$1.84 = \$5.52; \$3.68 + \$3.99 = \$7.67; \$1.84 + \$.15 = \$1.99.

(17.) \$.61 + \$.05 = \$.66; \$3.10 + \$.52 = \$3.62; \$18-.53 + \$2.32 = \$20.85; \$7.17 − \$.30 − \$6.87.

(18.) By the first method, \$24.96; \$24.96 − \$2.08 = \$22.88; \$24.96 + \$2.08 = \$27.04; \$24.96 + \$4.16 = \$29.12; \$24.96 + \$8.32 + \$1.39 = \$34.67.

(19.) \$45.052 + \$11.263 = \$56.315.

(20.) Interest \$2.353 + \$.392 = \$2.745.

(21.) By the first method to the nearest cent. Interest for 2 yr. \$55.41 − \$4.62 = \$50.79; for 2 yr. 3 mo. \$62.34 − \$5.20 = \$57.14; for 3 yr. 4 mo. \$92.35 − \$7.70 = \$84.65; for 4 yr. 5 mo. \$122.36 − \$10.20 = \$112.16.

(21.) By the second method. Interest for 2 yr. \$50.7925; for 3 mo. \$6.34906; for 3 yr. \$76.18875; for 4 mo. \$8.46542; for 4 yr. \$101.585; for 5 mo. \$10.58177.

(22.) By the first method. Interest for 5 yr. 6 mo. \$304.755 − \$76.189; for 6 yr. 7 mo. \$364.78 − \$91.20 = \$273.68; for 7 yr. 8 mo. \$424.81 − \$106.20 = \$318.61.

(22.) By the second method. Interest for 5 yr. $207.7875; for 6 mo. $20.77875; for 6 yr. $249.345; for 7 mo. $20.7787 + $3.4631; for 7 yr. $290.9025; for 8 mo. $20.77875 + $6.92625.

(23.) First method. Interest for 6 yr. 9 mo. $561.02625 + $140.25656 = $701.28281; int. for 7 yr. 10 mo. $651.0675 + $162.7669 = $813.8344; int. for 9 yr. 11 mo. $824.22375 + $206.0559375 = $1030.2796875.

(23.) By second method. Interest for 1 yr. $103.89375; for 6 yr. $623.36 + 6 mo. $51.95 + for 3 mo. $25.97 = $701.28.

For 7 yr. $727.26 + for 6 mo. $51.95 + for 4 mo. $34.63 = $813.84.

For 10 yr. $1038.94 — 1 mo. $8.66 = $1030.28.

(24.) First method. Interest for 3 mo. 15 da. $.615 + .051 = $.666; for 8 mo. 24 da. $1.545 + $.129 = $1.674; for 1 yr. 5 mo. 20 da. $3.103 + $.258 = $3.361.

(24.) Second method. Interest for 1 yr. $2.283125; for 3 mo. $.570781 + do. for 15 da. $.09513 = $.666.

For 6 mo. $1.1415625 + for 2 mo. $.380520 + for 20 da. $.12684 + 4 da. $.02537 = $1.67429.

For 1 yr. $2.283125 + 4 mo. $.76104 + 1 mo. $.19026 + 20 da. $.12684 = $3.36127.

(25.) First method. Interest for 3 yr. 2 mo. 27 da., at 6 per cent., $13.6636; for 8 yr. 9 mo. 15 da., at 7 per cent., $37.05687 + $6.17614 = $43.233; for 3 yr. 4 mo. 24 da., at 5¼ per cent., $14.331 — $1.791375 = $12.539625.

(25.) Second method. Interest for 1 yr. $4.215; for 3 yr. $12.65 + for 2 mo. $.70 + for 20 da. $.23 + 5 da. $.06 + 2 da. $.02 = $13.66.

For 8 yr. at 7 per cent. $39.34 + 6 mo. $2.46 + for 3 mo. $1.23 + 15 da. $.20 = $43.23.

At 5¼ per cent. for 3 yr. $11.06 + 4 mo. $1.23 + 24 da. $.25 = $12.54.

(27.) Interest of £1 for 8 mo. 15 da. = £.042½; of £150.3 = £6.388; int. of £1 for 3 mo. 18 da. = £.018; of £75.775 = £1.364; int. of £1 for 3 yr. 7 mo. 25 da. £.219⅛; of £950.982 = £208.424; int. of £1 for 1 mo. 14 da. at 6 per cent. = £.007⅛; of £105.039 at 4½ per cent. = £.7703 — £.1926 = £.5777.

109a. (2.) Prin. bearing int. from July 1, 1846, 450.00
Interest to April 1, 1847, 9 mo., 20.25
Amount due April 1, 1847, 470.25
First payment, 70.00
Balance for a new principal, 400.25
Int. on bal. from April 1 to Oct. 1, 6 mo., 12.01
2d payment, which is less than the int. due, 5.
Excess of interest still due, 7.01
Int. on same principal to Feb. 1, 1848, 4 mo., 8.01
Interest due Feb. 1, 1848, 15.02
Amount due Feb. 1, 1848, 415.27
Third payment more than interest due, 50.00
Balance for new principal, 365.27
Int. of balance from Feb. 1 to July 1, 5 mo., 9.13
Balance due July 1, 374.40

(3.) Principal bearing interest from June 5, 1847, 200.00
Interest to July 5, 1 mo., 1.00
Amount due July 5, 201.00
First payment, to be deducted from the amount, 75.00
Balance for new principal, 126.00
Int. from July 5, 1847, to Feb. 20, 1848, 7 mo. 15 da., 4.73
Amount due Feb. 20, 1848, 130.73
Second payment, 115.00
Balance due Feb. 20, 1848, 15.73
Interest from Feb. 20 to Sept. 5, 6 mo. 16 da., .51
Balance due Sept. 5, 16.24

(4.) Principal bearing interest from June 16, 1845, 200.00
Interest to Nov. 16, 1845, 5 mo., 5.83
Amount due Nov. 16, 205.83
First payment, 55.00
Balance for a new principal, 150.83
Int. from Nov. 16, 1845, to Aug. 16, 1846,
9 mo., at 7 per cent., 7.92
Second payment, less than int. due, 6.00
Excess of interest, 1.92
Int. from Aug. 16, '46, to March 1, '47, 6 mo. 13 da., 5.66
Interest due March 1, 1847, 7.58
Amount due March 1, 1847, 158.41
Third payment, 10.00
Balance for new principal, 148.41
Int. from March 1, 1847, to June 16, 3 mo. 15 da., 3.03
Amount due June 16, 151.44

Brought up,		$151.44
Fourth payment,		75.00
Balance for new payment,		76.44
Interest from June 16 to Nov. 16, 5 mo.,		2.23
Balance due Nov. 16, 1847,		78.67
(5.) Principal bearing int. from April 1, 1848,		$500.00
Int. from April 1 to Nov. 15, 7 mo. 14 da.,	18.67	
First payment, less than interest,	12.00	
Excess of interest,	6.67	
Int. on same principal from Nov. 15, 1848, to May 23, 1849, 6 mo. 8 da.,	15.67	
Interest due May 23, 1849,	22.34	22.34
Amount due May 23, 1849,		522.34
Second payment,		75.00
Balance for new principal,		447.34
Int. from May 23 to Sept. 20, 3 mo. 28 da.,		8.80
Amount due Sept. 20,		456.14
Third payment,		10.00
		446.14
Int. from Sept. 20, 1849, to April 1, 1850, 6 mo. 12 da.,		14.28
Balance due April 1, 1850,		460.42
(6.) Principal bearing int. from June 10, 1844,		$1750.00
Interest to Sept. 15, 3 mo. 5 da.,		27.71
Amount due Sept. 15, 1844,		1777.71
First payment,		150.00
Balance for a new principal,		1627.71
Int. from Sept. 15, '44, to Apr. 1, '45, 6 mo. 17 da.,	53.44	
Second payment, less than interest due,	50.00	
Excess of interest,	3.44	
Int. on same prin. from Apr. 1 to Sept. 12, 5 mo. 11 da.,	43.68	
Interest due Sept. 12,	47.12	
Third payment,	40.00	
Excess of interest,	7.12	
Int. from Sept. 12 to Jan. 7, 1846, 3 mo. 26 da.,	31.47	
Interest due Jan. 7, 1846,	38.59	38.59
Amount due Jan. 7, 1846,		1666.30
Fourth payment,		500.00
Balance for a new principal,		1166.30
Int. from Jan. 7 to May 12, 1847, 4 mo. 5 da.,	24.30	
Fifth payment, less than interest due,	15.00	
Excess of interest,	9.30	
Int. from May 12 to July 17, 2 mo. 5 da.,	12.63	
Interest due July 17,	21.93	21.93
Amount due July 17,		1188.23

Brought up,	$1188.23
Sixth payment,	500.00
Balance for new principal,	688.23
Int. from July 17, 1846, to March 25, 1847, 8 mo. 8 da.,	28.45
Balance due March 25, 1847,	716.68

109b. The answer to example 1, Art. 110, by the legal rule is $142.99

The answer to example 2, Art. 110, by the legal rule is $511.70

110a. (1.)

Amount of $375 from Aug. 16, 1848, to April 16, 1849, 8 mo.,	$15.00	+	$375 =	$390.00
Amount of $50 from Sept. 1, 1848, to April 16, 1849, 7 mo. 15 da.,	1.88	+	50 =	51.88
Amount of $75 from Oct. 16, 1848, to April 16, 1849, 6 mo.,	2.25	+	75 =	77.25
Amount of $80 from Nov. 1, 1848, to April 16, 1849, 5 mo. 15 da.,	2.20	+	80 =	82.20
Amount of $35.43 from Jan. 16, 1849, to April 16, 1849, 3 mo.,	.53	+	35.43 =	35.96
Amount of all the endorsements,				$247.29

$390.00 — $247.29 = $142.71, balance due April 16, 1849.

(2.) Amount of $1000 from Nov. 17, 1848, to Sept. 25, 1849, 10 mo. 8 da.,	$1051.33
Amount of $100 from Dec. 12, 1848, to Sept. 25, 1849, 9 mo. 13 da.,	104.72
Amount of $75 from Jan. 20, 1849, to Sept. 25, 1849, 8 mo. 5 da.,	78.06
Amount of $150 from March 3, 1849, to Sept. 25, 1849, 6 mo. 22 da.,	155.05
Amount of $200 from July 15, 1849, to Sept. 25, 1849, 2 mo. 10 da.,	202.33
	$540.16

$1051.33 — $540.16 = $511.17, balance due Sept. 25, 1849.

(3.)

Am't of $200 for 2 yr. 5 mo.,	$33.33	+	$200 =		$233.33
" 55 for 2 yr.,	7.70	+	55 =	$62.70	
" 6 for 15 mo.,	.52	+	6 =	6.52	
" 10 for 8 mo. 15 da.,	.50	+	10 =	10.50	
" 75 for 5 mo.,	2.19	+	75 =	77.19	156.91
Balance due Nov. 16, 1847,					$76.92

(4.)

Am't of $500 for 2 yr.,	$60.00	+	$500 =		$560.00
" 12 for 1 yr. 4 mo. 17 da.,	.99	+	12 =	$12.99	
" 75 for 10 mo. 9 da.,	3.86	+	75 =	78.86	
" 16 for 6 mo. 12 da.,	.32	+	10 =	10.32	$102.17
Balance due April 1, 1850,					$457.83

(5.)

Am't of $500 for 9 mo.,	$522.50	$150 for 9 mo. 17 da.,	$157.17
" 350 for 6 mo. 17 da.,	361.49	375 for 7 mo. 24 da.,	389.63
" 175 for 3 mo. 5 da.,	177.77	350 for 2 mo. 17 da.,	354.49
	$1061.76		$901.29

Balance due Jan. 1, 1849, $1061.76 — $901.29 = $160.47.

(6.)

Am't of $ 75 for 6 mo. 21 da.,	$ 78.35	$100 for 7 mo. 14 da.,	$104.98
" 210 for 5 mo. 16 da.,	217.75	200 for 6 mo. 16 da.,	208.71
" 100 for 3 mo.,	102.00	150 for 6 mo. 16 da.,	156.53
" 100 for 28 da.,	100.62	250 for 5 mo. 11 da.,	258.94
	498.72	100 for 2 mo. 24 da.,	101.87
			$831.03

Balance due, $831.03 — $498.72 = $332.31.

(7.)

Am't of $75 for 11 mo. 17 da.,	$80.42	$200 for 9 mo. 7 da.,	$211.54
" 150 " 9 mo. 12 da.,	158.81	150 " 6 mo. 26 da.,	156.44
" 248.54 " 5 mo. 17 da.,	257.19	75 " 4 mo. 23 da.,	77.23
" 84.75 " 3 mo. 26 da.,	86.80	50.50 " 2 mo. 17 da.,	51.31
" 189.48 " 2 mo. 5 da.,	192.05	148.75 " 22 da.,	149.43
	$775.27		$645.95

Balance due Stetson, $775.27 — $645.95 = $129.32.

110b. The answer to example 1, Art. 109, by the second method, is $520.01
The answer to example 2, by the second method, is $372.27
The answer to example 3, by the second method, is $ 15.99
The answer to example 6, by the second method, is $697.79

111a. (3.) Annually. First principal, $1000; second, $1060; third, $1123.60; fourth, $1191.016; fifth, $1226.746.

Semi-annually. $1000; $1030; $1060.90; $1092.727; $1125.509; $1159.274; $1194.052; $1229.874.

Quarterly. $1000; $1015; $1030.225; $1045.678; $1061.363; $1077.283; $1093.442; $1109.844; $1126.492; $1143.389; $1160.54; $1177.948; 1195.617; $1213.561; $1231.765.

(4.) At 5½ per cent., $500; $513.75; $527.878; $542.395; $557.311; $572.637; $588.385; $596.495.

At 6 per cent., $500; $515; $530.45; $546.363; $562.754; $579.637; $597.026; $605.981.

(5.) £100.525; £104.546; £108.728; £113.077.

111b. (3.) . . $750 at 6 per cent., 2½ yr. . . annually; semi-annually, quarterly, at 6 per cent.

Ans. $867.98; $869.455; $870.405.

(5.) £35 7s. . . $5\frac{1}{4}$ yrs. at 6 per cent.? Ans. £48 0s. 4d.

112a. (2.) $\$200 \times .022\frac{1}{12} = \$4.583$, and $\$45.83 \div \$4.583 = 10$. $\$200 \times .043\frac{1}{4} = \$8.65$, and $\$45.83 \div \$8.65 = 5.3$ nearly.

(4.) $\$41.65 \div \$22.10 = 1\frac{33}{442}$ yr. $= 1$ yr. 10 mo. 18 da.

(5.) $\$500 \div \$30 = 16\frac{2}{3}$ yr.; $\$500 \div \$40 = 12\frac{1}{2}$ yr.; $\$500 \div \$37.50 = 13\frac{1}{3}$ yr.

(6.) $\$1 \div \$.06 = 16\frac{2}{3}$; $\$1 \div \$.08 = 12\frac{1}{2}$; $\$1 \div \$.075 = 13\frac{1}{3}$; $\$1 \div \$.045 = 22\frac{2}{9}$; $\$1 \div \$.15 = 6\frac{2}{3}$.

(8.) $\$75 \div .0275 = \$2727.27$. (9.) $\$650 \div .495 = \$1313.13$.

(11.) Amount of $\$1 = \$.09 - \$.0075 + \$1 = \$1.0825$. $\$1000 \div 1.0825 = \$923.79$.

(12.) $\$854 \div 1.2 = \$711.67$. (13.) $\$150 \div 1.12 = \$133.93$.

(14.) $\$500 \div 1.195 = \$418.41$; $\$500 \div 1.3 = \$384.62$; $\$500 \div \$1.27 = \$393.70$; $\$500 \div 1.1375 = \$439.56$.

(15.) $\$100 \div 1.21 = \$82.64$; $\$100 \div 1.2275 = \$81.47$; $\$100 \div 1.1925 = \$83.86$; $\$100 \div 1.28 = \$78.13$.

112b. (2.) . . \$70.25 . . to gain \$12.54 in 3 yr. 4 mo. 24 da.? Ans. $5\frac{1}{4}$ per cent.

(5.) . . \$475 . . \$625 . . at 5 per cent.? at $6\frac{1}{2}$ per cent.? Ans. 6 yr. 3 mo. 24— da.; 4 yr. 10 mo. 9 da.

(6.) . . triple itself at 6 per cent.? $8\frac{1}{3}$ per cent.? Ans. 33 yr. 4 mo.; 23 yr. 6 mo. $10\frac{10}{17}$ da.

(9.) . . \$345.27 in 2 yr. 5 mo., at 6 per cent.? Ans. \$2381.17.

(12.) . . at $5\frac{1}{2}$ per cent., \$540 in 2 yr. 6 mo.? Ans. \$474.72.

(14.) . . \$600 due in 4 yr. 5 mo. 15 da., at 5 per cent.? Ans. \$490.63.

113a. (1.) $\$500 \times .03 = \$15$. (2.) $\$350 \times .04\frac{2}{3} = \$16.33$; and $\$350 - \$16.33 = \$333.67$.

(3.) $\$500 \times .03 = \$15$; $\$500 \times .06 = \$30$. $\$1000 - (\$15 + \$30) = \$955$.

(4.) $\$578 \times .02\frac{2}{5} = \$13.87$. $\$578 - \$13.87 = \$564.13$.

(5.) $\$125 \times .04\frac{1}{2} = \$5.625$. $\$125 - \$5.625 = \$119.375$.

(6.) $\$.37\frac{1}{2} \times .08 = \$.03$. $\$.37\frac{1}{2} - \$.03 = \$.34\frac{1}{2}$.

(7.) $\$93.75 \times .04\frac{1}{2} = \$4.22$. $\$93.75 - \$4.22 = \$89.53$.

113b. (2.) $1000 . . 4 mo. . . 8 per cent.? $26.67; $973.33.

(3.) . . $1500 . . $\frac{1}{3}$ in 4 mo. . . $\frac{2}{3}$ in 8 mo. . . $\frac{3}{4}$ per cent. per mo.? Ans. $1425.

(5.) . . $148 . . 4 mo. . . $1\frac{3}{4}$ per cent. per mo.? Ans. $137.64.

(6.) . . 75 cents . . $33\frac{1}{3}$ per cent.? Ans. 50 cents.

(7.) . . 875 lb. at $15\frac{1}{2}$ cents, on 4 mo. . . 10 per cent.? Ans. $131.11.

116a. (1.) $500 × .0055 = 2.75. $500 — $2.75 = $497.25.

(2.) $575 × .0205 = $11.79. $575 — $11.79 = $563-.21.

(3.) The note falls due Dec. 21, having 26 days to run after it is discounted. $300 × .004$\frac{1}{3}$ = $1.30. $300 — $1.30 = $298.70.

(4.) The note is payable Feb. 23, 2 mo. 11 da. after it is discounted; $150 × .011$\frac{5}{6}$ = $1.775; and $150 — $1.775 = $148.225.

(5.) Corn, $312.50; rye, $65.63; oats, $90. Amount, $468.13, payable March 18, 2 mo. 17 da. after it is discounted. $468.13 × .017$\frac{1}{2}$ = $8.01; and $468.13 — $8.01 = $460-.12.

(6.) The note has 2 mo. 5 da. to run after it is discounted; $400 × .010$\frac{5}{6}$ = $4.33, and $400 — $4.33 = $395.67.

116b. (2.) $350 . . . 6 mo.? Ans. $339.325.

(3.) Note of $750, date July 22, 1849, for 60 da. . . discounted Aug. 12? Ans. $744.875.

(4.) $375, dated April 13, on 2 mo., discounted June 4? Ans. $374.25.

(5.) Salem, June 15, 1849. 350 bu. corn, at $.75; 134 bu. rye, at $.85; 300 bu. oats, at $.42$\frac{1}{2}$. Sold at 4 mo. . . note discounted Aug. 4, at 7 per cent.? Ans. $503.90 — $7.25 = $496.65.

117a. (2.) $350 ÷ .9845 = $355.51; $350 ÷ .9819 = $356.35; $350 ÷ .9793 = $357.40. Or by the table, page 261. $1.01574 × 350 = $355.51; $1.01842 × 350 = $356.45.

(3.) $1000 ÷ .9895 = $1010.61; $1000 ÷ .99125 = $1008.83.

(4.) $450 ÷ .987 = $455.93.

117b. (2.) $150 . . 4 mo. . . 6 per cent.? 7 per cent.?
Ans. 153.14; $153.68.

(3.) $500 . . 6 mo. . . 6 per cent.? 8 mo., at 7 per cent.?
Ans. $515.73; $524.80.

118a. (2.) Interest for 63 days = $260 × .0105 = $2.73; exchange, $260 × .01¼ = $3.25. $259.60 — $5.98 = $253.62.

(3.) The draft is payable May 24; int. for 2 mo. 16 da. = $3519 × .012⅔ = $44.57; exchange, $3519 × .00¼ = $8.80. $3518.75 — $53.37 = $3465.38.

(4.) $200 × .00½ = $1. $200 — $1 = $199.

118b. (1.) . . $150, date Oct. 22, 1849, . . 3 mo. . . discounted Nov. 27th . . exchange ½ per cent.?
Ans. $147.77.

(2.) $375.75 . . Aug. 5, 1849. . . Cincinnati 30 days . . exchange ¾ per cent.? Ans. $375.75 — $4.89 = $370.86.

(3.) . . on Baltimore for $1500.25 . . dated Oct. 3, 1849, payable in 4 mo., discounted Nov. 8, exchange ¾ per cent.?
Ans. $1500.25 — ($22.25 + $11.25) = $1466.75.

119a. The pupil may be required, *at recitation*, to perform the first 16 examples of this article, mentally, without referring to his slate.

(5.) $\frac{1}{25} = 4$ per cent.; $\frac{1}{5} = 20$ per cent.; $\frac{2}{5} = 40$ per cent., &c.

(6.) $\frac{20}{500} = \frac{1}{25} = 4$ per cent.; $\frac{40}{500} = \frac{2}{25} = 8$ per cent., &c.

(15.) 50 cents is $\frac{1}{2}$ of the cost.

(16.) $\frac{1500}{10000} = \frac{15}{100} = 15$ per cent.

(17.) $\frac{3}{105\frac{1}{4}} = \frac{6}{211} = .0284$ nearly.

(18.) Cost $375. Sold for $412.50. Discount ($413 × .015½ = $6.40) + $2.13 = $8.53. $412.50 — $8.53 = $403.97, the net proceeds of the note. $403.97 — $375 = $28.97, and $28.97 ÷ $375 = .07725.

Or, discount ($5.50 × .015½ = $.08525) + $.02842 = $.11367. $5.50 — $.11367 = $5.38633, the net proceeds per barrel. $5.38633 — $5 = $.38633, and $.38633 ÷ $5 = .07725.

(19.) $\$700 \times .15 = \$105$. $\$805 \div \$3000 = .26\frac{5}{6}$.

(20.) $\frac{1500}{5000} = \frac{15}{50} = \frac{30}{100} = 30$ per cent.

(21.) 65 cents are $\frac{11}{100}$ of what? Ans. If 65 cents are $\frac{11}{100}$, $\frac{1}{100}$ must be $\frac{1}{11}$ of 65 cents $= \frac{65}{112}$, and $\frac{100}{100}$ are 100 times $\frac{65}{112} = \frac{6500}{112} = 58\frac{1}{28}$ cents.

(22. Note.) He will sell it for $\frac{10\frac{3}{4}}{8} = \frac{43}{32}$ of 92 per cent. = $123\frac{1}{8}$ per cent. of the cost.

(23.) Ans. I shall sell it for $\frac{625}{587\frac{1}{2}} = \frac{50}{47}$ of 94 per cent. = 100 per cent. of the cost; . . $\frac{650}{587\frac{1}{2}} = \frac{52}{47}$ of 94 per cent. = 104 per cent. of the cost.

(24.) $\frac{75}{450} = \frac{1}{6} = 16\frac{2}{3}$ per cent.

(25.) $\$14.40$ are 8 per cent. of the cost; the cost is therefore $\frac{100}{8} = 12\frac{1}{2}$ times the gain $= \$180$; $\$180 \div 300 = 60$ cents.

(26.) He will sell his goods for $87\frac{1}{2}$ per cent. of 125 per cent. $= 109\frac{3}{8}$ per cent. of the cost.

119b. (4.) . . $\$5.50$. . $\$6.50$?

Ans. Gain $18\frac{2}{11}$ per cent.

(8.) . . 23 cents . . gains 15 per cent.?

Ans. Cost 20 cents.

(11.) . . $\$2.60$. . lost 20 per cent.?

Ans. Cost $\$3.25$.

(17.) . . $\$102\frac{1}{2}$. . sells at $\$98\frac{1}{4}$?

Ans. $4\frac{8}{41}$ per cent.

(23.) . . 4.95 . . lose 10 per cent. . . $\$5.25$?

Ans. Loss $4\frac{6}{11}$ per cent.

(24.) . . $\$3.75$. . to $\$4.87\frac{1}{2}$. . . ? Ans. 30 per cent.

(25.) Sold 175 bu. . . $\$12.25$. . $10\frac{1}{2}$ per cent.?

Ans. $\$.66\frac{2}{3}$.

(26.) . . 20 per cent. . . 10 per cent.?

Ans. 8 per cent.

120a. (2.) $(60 + 200 + 400) \div 150 = 4\frac{2}{5}$.

(5.)

April	1,	$75	days	
April	21,	80	20 =	1600
May	1,	45	30 =	1350
May	16,	30	45 =	1350
		230		)4300
				19 days.

(6.)	October	1,	$175	days	
	October	26,	250	25 =	6,250
	Nov.	21,	450	51 =	22,950
	Dec.	12,	100	72 =	7,200
			975		36,400

37 days.

(7.)	November	10,	$200	days	
	December	15,	110	35 =	3850
	November	25,	150	15 =	2250
			460		6100

13 days.

(8.) Caleb A. Moore to J. P. Williams, Dr.

Jan.	15,	1849.	To a bill of goods at		4 mo.,	$354.87	due May	15
Jan.	25,	"	"	"	3 mo.,	608.50	" April	25
Feb.	20,	"	"	"	4 mo.,	150.00	" June	20
March	25,	"	"	"	2 mo.,	175.18	" May	25

The earliest day at which any charge is due is April 25.

From April 25	to	May	15,	20 days ×	$354.87 =	7097.40
" "	"	April	25,	—	608.50	
" "	"	June	20,	56 days ×	150.00 =	8400.00
" "	"	May	25,	30 days ×	175.18 =	5255.40
					1288.55	20752.80

16 days
after April 25th, May 11th.

(9.) A. B. to Andrew Jackson, Dr.

'48 May 16.	For 875 lb. Sugar, at 8¼c.	on 3 mo.,	$72.19	due Aug.	16
" July 7.	" 350 gal. Mol's, at 24c.	on 4 mo.,	84.00	" Nov.	7
" July 7.	" 500 lb. Rice, at 5½c.	on 2 mo.,	27.50	" Sept.	7
" July 18.	" 175 lb. Tea, at 37½c.	on 3 mo.,	65.62½	" Oct.	18
" Aug. 3.	" 50 bbls. Flour, at $5.75	cash,	287.50	" Aug.	3
" Aug. 8.	" 850 yds. Cottons, at 12½c.	6 mo.,	106.25	" Feb. 8,	'49
			$643.06		

The earliest date at which any charge is due is Aug. 3.

From Aug. 3	to	Aug.	16, is	13 da. ×	$72.19 =	938.47
" "	"	Nov.	7, is	96 da. ×	84.00 =	8,064.00
" "	"	Sept.	7, is	35 da. ×	27.50 =	962.50
" "	"	Oct.	18, is	76 da. ×	65.62½ =	4,987.50
" "	"	Aug.	3, is	00 da. ×	287.50 =	
" "	"	Feb.	8, is	189 da. ×	106.25 =	20,081.25
					643.06	35,033.72 (54 da.

after Aug 3d, or Sept. 26th.

(10.) James Robinson to A. B., Dr.

'49 Feb.	6.	To 1525 lb. Pork, at 7½c. on 3 mo.,	$114.375	due May	6	
" Feb.	20.	" 825 lb. Beef, at 8½c. on 2 mo.,	70.125	" April	20	
" March	10.	" 1000 b. Corn, at 62½c. on 2 mo.,	625.00	" May	10	
" April	3.	" 470 b. Oats, at 37½c. on 3 mo.,	176.25	" July	3	
" April	10.	" 1548 lb. Cheese, at 8c. cash,	123.84	" April	10	
" April	10.	" 285 lb. Butter, at 16c. cash,	45.60	" April	10	
" May	1.	" 75 b. Wheat, $1.15 on 2 mo.,	86.25	" July	1	
			$1241.44			

From April 10 to May 6 is 26 da.	×	$114.375	=	2,973.75
" " " April 20 is 10 da.	×	70.125	=	701.25
" " " May 10 is 30 da.	×	625.	=	18,750.00
" " " July 3 is 84 da.	×	176.25	=	14,805.00
" " " April 10 is 00 da.	×	123.85	=	———
" " " April 10 is 00 da.	×	45.60	=	———
" " " July 1 is 82 da.	×	86.25	=	7,072.50
		1241.44		)44,302 50(36 da.

from April 10, or May 16.

120b. See the pages referred to, viz., 161, 162, 164, 165, from which additional exercises may be taken.

121a. (1.) $540.50 × $\frac{9}{10}$ = 121.6125 = £121 12s. 3d. sterling.

$540.50 × $\frac{1}{2}$ = 135.125 = £135 2s. 6d. Canada.

$540.50 × $\frac{3}{10}$ = 162.15 = £162 3s. New England.

$540.50 × $\frac{2}{5}$ = 216.2 = £216 4s. New York.

$540.50 × $\frac{3}{8}$ = 202.6875 = £202 13s. 9d. Pennsylvania.

$540.50 × $\frac{7}{30}$ = 126.11$\dot{6}$ = £126 2s. 4d.

(2.) £52 7s. 8d. = £52.38$\dot{3}$. £52.38$\dot{3}$ sterling × 4$\frac{4}{9}$ = 232.815.

£52.38$\dot{3}$ Canada × 4 = 209.533; £52.38$\dot{3}$ New England × 3$\frac{1}{3}$ = $174.611.

£52.38$\dot{3}$ New York × 2$\frac{1}{2}$ = $130.958; £52.38$\dot{3}$ Pennsylvania × 2$\frac{2}{3}$ = $139.689.

£52.38$\dot{3}$ Georgia × 4$\frac{2}{7}$ = $224.50.

(3.) $1.25 × $\frac{9}{40}$ = .281 = 5s. 7½d. sterling.

$1.25 × $\frac{1}{4}$ = .3125 = 6s. 3d. Canada.

$1.25 × $\frac{3}{10}$ = 7s. 6d. New England.

$1.25 × $\frac{2}{5}$ = .5 = 10s. New York.

$1.25 × $\frac{3}{8}$ = .46875 = 9s. 4½d. Pennsylvania.

$1.25 × $\frac{7}{30}$ = .291$\dot{6}$ = 5s. 10d. Georgia.

(4.) 7s. 6d. = £.375. £.375 sterling × 4$\frac{4}{9}$ = 1.66\dot{6}$; £.375 Canada × 4 = $1.50.

£.375 New England $\times 3\frac{1}{3} = \$1.25$.
£.375 New York $\times 2\frac{1}{2} = \$.9375$.
£.375 Pennsylvania $\times 2\frac{2}{3} = \$1$.
£.375 Georgia $\times 4\frac{2}{7} = \$1.607$.

122a. (2.) $1 \times \frac{40}{9} \times 1.09 = 4.8\dot{4}$; $17 \times \frac{40}{9} \times 1.09 = 82.35$; $.833 \times \frac{40}{9} \times 1.09 = 4.037$; $16.8875 \times \frac{40}{9} \times 1.09 = 81.81$; $8.024 \times \frac{40}{9} \times 1.09 = 38.8718$.

(3.) $1 \times \frac{9}{40} \times \frac{100}{110} = \frac{9}{40} \times \frac{10}{11} = \frac{9}{44}$, £$\frac{9}{44}$ = 4s. 1.09d. £$\frac{9}{44} \times 15.5 =$ £$\frac{1395}{440} =$ £$\frac{279}{88} =$ £3 3s. 5d.
£$\frac{9}{44} \times 175.83 =$ £$\frac{1582.47}{44} =$ £35 19s. $3\frac{3}{4}$d.
(4.) $\frac{9}{40} \div 1.0875 = \frac{30}{145} = \frac{6}{29}$. $\$1 =$ £$\frac{6}{29}$. £$\frac{6}{29} \times 100 =$ £$\frac{600}{29} =$ £20 13s. $9\frac{1}{2}$d.; £$\frac{6}{29} \times 54.75 =$ £$\frac{328.5}{290} =$ £11 6s. $6\frac{1}{4}$d.; £$\frac{6}{29} \times 1575 =$ £$\frac{2250}{29} =$ £325 17s. 3d.
(5.) $\$\frac{40}{9} \times 1.0875 = \frac{145}{30} = \frac{29}{6} = \$4\frac{5}{6}$.
$\$4\frac{5}{6} \times 100 = \$483.33$; $\$4\frac{5}{6} \times 75.928 = \$366.986$.
$\$4\frac{5}{6} \times 1500.4375 = \$7252.115$.

122b. (2.) . . $9\frac{1}{2}$ per cent. . . £144 5s. 6d.? . . £875 4s. 6d.? Ans. \$702.07; \$4259.428.
(3.) . . $9\frac{1}{4}$ per cent. . . \$1050.75? . . \$2500? Ans. £216 8s. $0\frac{1}{4}$d.; £514 17s. 6d.

See Art. 124, questions 19 and 20.

123a. (2.) One bushel will cost $\frac{4}{13}$ of \$1.95, and $15\frac{7}{8}$ bushels will cost $\frac{127}{8}$ of $\frac{4}{13}$ of $1.95 = \$9.52\frac{1}{2}$; $\frac{309}{16}$ of $\frac{4}{13}$ of $1.95 = \$11.58\frac{3}{4}$.
(3.) $\frac{15}{4}$ of $\frac{8}{201}$ of $2.55 = \$\frac{8}{670} = \$.38\frac{4}{67}$; $\frac{47}{8}$ of $\frac{8}{201}$ of $2.55 = \$\frac{3995}{67700} = \$.59\frac{42}{67}$.
(4.) $\frac{127}{8}$ of $\frac{16}{49}$ of $.63 = \frac{2286}{700} = \$3.26\frac{4}{7}$; $\frac{251}{10}$ of $\frac{16}{49}$ of $.63 = \$\frac{4518}{875} = \$5.16\frac{12}{35}$.
(5.) $\frac{100}{55}$ of $\frac{33}{8} = \frac{5}{4}$ of $\frac{3}{2} = 7\frac{1}{2}$ A.; $\frac{15025}{5500}$ of $\frac{33}{8} = \frac{601}{200}$ of $\frac{3}{8} = \frac{1803}{1600} = 11\frac{443}{1600}$ A.; $\frac{2146}{9}$ of $\frac{1}{55}$ of $\frac{33}{8} = \frac{1078}{3}$ of $\frac{1}{5}$ of $\frac{1}{4} = 17\frac{23}{60}$ A.
(7.) $\frac{79}{9}$ of $\frac{9}{41}$ of $\$\frac{11}{3} = \$\frac{869}{123} = \$7.06\frac{62}{123}$; $\frac{29}{9}$ of $\frac{9}{41}$ of $\$\frac{11}{3} = \$\frac{857}{328} = \$2.91\frac{63}{82}$; $\frac{54}{5}$ of $\frac{9}{41}$ of $\$\frac{11}{3} = \$8.69\frac{11}{41}$.
(8.) $\frac{37}{10}$ of $\frac{10}{53}$ of $70.50 = \$\frac{6217}{106} = \$49.21\frac{37}{53}$.
$\frac{113}{8}$ of $\frac{10}{53}$ of $70.50 = \frac{79665}{424} = \$187.88\frac{97}{106}$.
$\frac{501}{20}$ of $\frac{10}{53}$ of $70.50 = \$\frac{7064.1}{212} = \$333.21\frac{12}{53}$.
(9.) $\frac{37}{9}$ of $\frac{8}{29}$ of $\$\frac{10}{3} = \$\frac{370}{87} = \$4.25\frac{25}{87}$; $\frac{15}{4}$ of $\frac{8}{29}$ of $\$\frac{10}{3} = \frac{100}{29} = \$3.44\frac{24}{29}$; $\frac{89}{10}$ of $\frac{8}{29}$ of $\$\frac{10}{3} = \$\frac{712}{87} = \$8.18\frac{34}{87}$.

(10.) $\frac{1}{6}$ is worth $\frac{1}{3}$ of \$3582, and $\frac{2}{6}$ are worth $\frac{2}{3}$ of \$3582 = \$9552.

(11.) The whole is worth $\frac{1}{5}$ of \$3000 = \$9600; $\frac{3}{4}$ is worth $\frac{3}{4}$ of $\frac{1}{5}$ of \$3000 = $\frac{3}{5}$ of \$3000 = \$7200; $\frac{5}{6}$ of $\frac{1}{5}$ of \$3000 = $\frac{5}{6}$ of \$3000 = \$8000.

(12.) $\frac{3}{8} + \frac{5}{12} + \frac{4}{9} = \frac{23}{72}$. One acre cost $\frac{72}{89}$ of \$375 = $\frac{\$27000}{89}$ = \$303.37$\frac{7}{89}$.

(13.) $\frac{7\frac{1}{2} \times 62\frac{1}{2}}{25} = \frac{15}{2} \times \frac{125}{2} \times \frac{1}{25} = \frac{3}{2} \times \frac{25}{2} = \frac{75}{4} =$ $18\frac{3}{4}$ gallons.

(14.) $\frac{25\frac{1}{2} \times 37\frac{1}{2}}{11\frac{1}{8}} = \frac{51}{2} \times \frac{31}{8} \times \frac{8}{9} = \frac{17}{2} \times \frac{31}{1} \times \frac{1}{3} = \frac{527}{6}$ $= 87\frac{5}{6}$ bushels.

(15.) $\frac{57}{2} \times \frac{125}{2} \times \frac{4}{35} = \frac{1425}{7} = 203\frac{4}{7}$ pounds.

(16.) $34 \times \frac{15}{8} \times \frac{8}{3} = 34 \times 5 = 170$.

(17.) The cost at \$1 per bu. would be \$950; at \$$\frac{3}{4}$ per bu., $\frac{3}{4}$ of \$950.

(18.) \$856 $\times \frac{1}{4}$ = \$214; \$856 $\times \frac{1}{3}$ = \$285$\frac{1}{3}$; \$856 $\times \frac{3}{8}$ = \$321.

(19.) The cost at £1 per acre would be £250; at £1$\frac{17}{40}$ per acre, $\frac{57}{40}$ of £250 = £356 5s.; at £3 9s. 5d. per acre, $3\frac{113}{240}$ = $\frac{833}{240}$ of £250 = £867$\frac{17}{24}$ = £867 14s. 2d.

(20.) At \$1 per cord, 35$\frac{7}{8}$ cords would come to \$35$\frac{7}{8}$; at \$4$\frac{7}{8}$ per cord, it would come to 4$\frac{7}{8}$ times \$35$\frac{7}{8}$. $\frac{\$287}{8} \times \frac{39}{8} =$ $\frac{\$11193}{64}$ = \$174.89$\frac{1}{16}$.

(21.) $\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} = \frac{57}{60} = \frac{19}{20}$. 285 is $\frac{10}{20}$ of $\frac{20}{19}$ of 285 = 300.

(22.) $\frac{4}{7} - \frac{4}{9} = \frac{8}{63}$. 60 is $\frac{8}{63}$ of 472$\frac{1}{2}$.

(23.) $5\frac{1}{5} - 4\frac{5}{9} = 4\frac{54}{45} - 4\frac{25}{45} = \frac{29}{45}$ mile apart in 1 hour, and $\frac{29}{45} \times 6 = \frac{58}{15} = 3\frac{13}{15}$ miles; $\frac{29}{45} \times \frac{21}{4} = \frac{203}{60} = 3\frac{23}{60}$ m's.

$4\frac{5}{9} + 5\frac{1}{6} = 4\frac{25}{45} + 5\frac{9}{45} = 9\frac{34}{45}$ miles apart in 1 hour; and $9\frac{34}{45} \times 6 = 58\frac{8}{15}$; $9\frac{34}{45} \times 5\frac{1}{4} = \frac{439}{45} \times \frac{21}{4} = \frac{3073}{60} = 51\frac{13}{60}$.

(24.) $50 \div \frac{29}{45} = 77\frac{17}{29}$; $50 \div 9\frac{34}{45} = \frac{50}{1} \times \frac{45}{439} = 5\frac{555}{439}$.

(26.) The first will fill $\frac{1}{3}$ of it in an hour, the second $\frac{1}{3}$ of it, and the third $\frac{1}{4}$ of it. They will all fill $\frac{13}{12}$ of it in an hour. They will therefore fill $\frac{12}{13}$ of it in $\frac{12}{13}$ of 1 hour = 55 minutes $23\frac{1}{13}$ seconds.

(27.) $\frac{1}{2} + \frac{1}{3} - \frac{1}{4} = \frac{7}{12}$ of it will be filled in 1 hour. It will therefore take $\frac{12}{7}$ of an hour to fill it = 1 hour 42 minutes $51\frac{3}{7}$ seconds.

(28.) The third pipe will fill it twice, and the fourth will empty it $1\frac{1}{2}$ times, in an hour; $\frac{1}{3} + \frac{1}{2} + 2 - \frac{4}{3} = 1\frac{1}{2}$. If all

were running together, it would be filled $1\frac{1}{8}$ times in 1 hour, or once in $\frac{8}{9}$ of an hour.

(29.) $2+3+4-9=0$.

(30.) \$1.00 in 5 years would at 6 per cent. amount to \$1.30; at $5\frac{1}{2}$ per cent., to \$1.275. The principal is, therefore, $\frac{100}{130}=\frac{10}{13}$ of the amount at 6 per cent.; and $\frac{100}{127\frac{1}{2}}=\frac{40}{51}$ of it at $5\frac{1}{2}$ per cent.; $\frac{10}{13}$ of \$1000 = \$769.23$\frac{1}{13}$; $\frac{40}{51}$ of \$1000 = \$784.31$\frac{10}{17}$.

(31.) The interest of \$1000 at 1 per cent. for 5 years would be \$50; and for 8 years, \$80. The rate must, therefore, be as many times 1 per cent. as there are times \$50 in \$500, for 5 years; and as there are times \$80 in \$500, for 8 years, or 10 per cent. and $6\frac{1}{4}$ per cent.

(32.) The interest of \$500 at 6 per cent., for 1 year, is \$30. Therefore, the time will be as many years as there are times \$30 in \$250, or $8\frac{1}{3}$ years.

(33.) I lost $\frac{5}{40}=\frac{1}{8}$ of the cost; $\frac{1}{8}=12\frac{1}{2}$ per cent.

(34.) \$20 is 8 per cent. of the cost; 1 per cent. of the cost would be $\frac{1}{8}$ of \$20; and 100 per cent. of the cost would be $\frac{100}{8}$ of it = $12\frac{1}{2}$ times \$20 = \$250.

(35.) Both can do $\frac{5}{6}$ of it in an hour; William can do $\frac{1}{3}$ of it in 1 hour. John can, therefore, do $\frac{5}{6}-\frac{1}{3}=\frac{1}{2}$ of it in an hour, or the whole in 2 hours.

123b. (3.) $27\frac{1}{4}$ lb. cost \$3.50 . . $6\frac{1}{8}$ lb.?
Ans. \$.78$\frac{73}{109}$.

(5.) $7\frac{3}{5}$ A. cost \$254.20 . . \$128$\frac{3}{8}$? Ans. $3\frac{26}{109}\frac{1}{4}$ A.

(9.) $4\frac{5}{8}$ bbls. \$6$\frac{3}{8}$. . $12\frac{1}{2}$ bbls.? Ans. \$17.49$\frac{17}{32}$.

(11.) $\frac{4}{7}$ of $\frac{5}{8}$ cost \$4000 . . whole? $\frac{3}{8}$?
Ans. \$11,200; \$4,200.

(15.) . . $7\frac{1}{4}$ cents per lb. . . $35\frac{1}{4}$ bu. at $45\frac{1}{2}$ cents?
Ans. $224\frac{12}{15}\frac{1}{8}$.

(21.) $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{9}$. . 2604 . . ? Ans. 4320.

(22.) $\frac{3}{8}$ exceeds $\frac{3}{10}$ by 45 . . ? Ans. 600.

(23.) . . $3\frac{4}{5}$ and $4\frac{5}{8}$. . in 6 hours? $7\frac{1}{2}$ hours?
Ans. *Same* direction $4\frac{19}{20}$; $6\frac{3}{16}$.
Ans. Opposite directions $50\frac{11}{20}$; $63\frac{3}{16}$.

(26.) . . 3 h., 4 h., 5 h.?
Ans. $1\frac{3}{17}$ h. = 1 h. 16 min. $35\frac{5}{17}$ sec.

(27.) . . 1st fill it in 4 h., 2d in 5 h., 3d empty it in 6 h.
Ans. $3\frac{9}{17}$ h. = 3 h. 31 m. $45\frac{15}{17}$ sec.

(29.) . . $\frac{1}{3}$ h., $\frac{1}{4}$ h., $\frac{1}{5}$ h., . . 4th empty it in $\frac{1}{6}$ h.?
Ans. $\frac{1}{4}$ hour.

(30, 31, 32.) See Art. 112.

(33.) . . \$45.50 . . \$37.50 . ? Ans. $17\frac{2}{31}$ per cent.
(34.) . . \$75 . . gained $12\frac{1}{2}$ per cent. ? Ans. \$66.66$\frac{2}{3}$.
(35.) . . 5 h. . . $2\frac{1}{4}$ h. . . ? Ans. $4\frac{1}{11}$ hours.

124a. (1.) \$500.75 × .143 = \$71.61 = interest at 6 per cent.
\$71 61 + \$5.97 = \$77.58 at $6\frac{1}{2}$ per cent.
\$71 61 + \$11.93 = \$83.54 at 7 per cent.
\$71 61 + \$17.90 = \$89.51 at $7\frac{1}{2}$ per cent.
\$71.61 + \$23 87 + \$5.97 = 101.45 at $8\frac{1}{2}$ per cent.
\$71 61 — \$17.90 = \$53.71 at $4\frac{1}{2}$ per cent.
\$71.61 — \$8.95 = \$62.66.

(2.) Principal bearing interest from June 27,	\$275.45
Interest from June 27 to Aug. 15, 1 mo. 19 da.,	2.25
Amount due Aug. 15, 1848,	277.70
First payment,	100.00
Balance for a new principal,	177.70
Interest from Aug. 15 to Oct. 8, 1 mo. 23 da.,	1.57
Amount due Oct. 8, 1848,	179.27
Second payment,	50.00
Balance for a new principal,	129.27
Interest from Oct. 8, 1848, to Jan. 17, 1849, 3 mo. 9 da.,	2.13
Amount due Jan. 17, 1849,	131.40
Third payment,	5.00
Balance for new principal,	126.40
Interest from Jan. 17 to April 12, 2 mo. 26 da.,	1.81
Amount due April 12, 1849,	128.21
Fourth payment,	50.00
Balance for a new principal,	78.21
Interest from April 12 to May 15, 1 mo. 3 da.,	.43
Amount due May 15, 1849, by the legal rule,	78.64

(2.) Amount of \$275.45 from June 27, 1848, to May 15, 1849, 10 mo. 18 da.,	\$290.05
Amount of \$100 from Aug. 15, 1848, to May 15, 1849, 9 mo.,	104.50
Amount of \$50 from Oct. 8, 1848, to May 15, 1849, 7 mo. 7 da.,	51.81
Amount of \$5 from Jan. 17, 1849, to May 15, 1849, 3 mo. 28 da.,	5.10
Amount of \$50 from April 12, 1849, to May 15, 1849, 1 mo. 3 da.,	50.28
Amount of endorsements,	211.69

\$290.05 — \$211.69 = \$78.36, balance due May 15, 1849, by the common method.

(3.) Cost $1000; sold for $1075.

$537.50 — disc. for 4 mo. $11.02 = $526.48.

$537.50 — disc. for 6 mo. $16.39 = $521.11.

$526.48 + $521.11 = $1047.59, the proceeds of the two notes.

$1047.59 — $1000 = $47.59 gain, $= 4\frac{759}{1000}$ per cent.

$537.50 — discount for 4 mo., at 9 per cent., $16.53 = $520.97.

$537.50 — discount for 6 mo., at 9 per cent., $24.59 = $512.91.

$520.97 + $512.91 = $1033.88, proceeds of both notes.

$1033.88 — $1000 = $33.88, gain.

(4.) $1300 × $1.02\frac{3}{4}$ = $1335.75; and $1335.75 — brokerage $3.25 = $1332.50.

Or better, the net value of the shares being $102.50 after deducting brokerage, $1300 × $1.02\frac{1}{2}$ = $1332.50.

At $4\frac{1}{2}$ per cent. discount, $1300 × $.95\frac{1}{2}$ = $1238.25.

At $12\frac{1}{2}$ per cent. premium, $1300 × $1.12\frac{1}{2}$ = $1459.25.

(5.) One dollar's worth at the par value will, at 10 per cent. premium, pay a debt of $1.10; the par value is, therefore, $\frac{10}{11}$ of the debt it will pay. $\frac{100}{110} = \frac{10}{11}$ of $500 = $454.54.

$\frac{100}{97}$ of $500 = $515.464; $\frac{100}{95\frac{1}{2}} = \frac{200}{191}$ of $500 = $523.56.

$\frac{100}{85} = \frac{20}{17}$ of $500 = $588.24; $\frac{100}{76\frac{3}{4}} = \frac{400}{307}$ of $500 = $651.47.

$\frac{100}{102\frac{1}{2}} = \frac{400}{410}$ of $500 = $489; $\frac{100}{105\frac{5}{8}} = \frac{800}{843}$ of $500 = $474.50.

(6.) $821.50 + $15.30 + $6.87 + $5 + $1.50 + $4.20 + $2 + $2.50 + $5.42 = $864.29.

($864.29 + $100) ÷ 3286 = 29\frac{113}{3286}$; ($864.29 + $75) ÷ 3286 = $.28$\frac{1221}{3286}$.

$864.29 × .05 = $43.2145; ($864.29 + 43.21) ÷ 3286 = $.27$\frac{1014}{1643}$.

864.29 × .07$\frac{1}{2}$ = $64.82175; ($864.29 + $64.82) ÷ 3286 = $.28$\frac{903}{3286}$.

(7.) $920.08 — $864.29 = $55.79; $864.29 — $788.64 = $75.65; $870.79 — $864.29 = $6.50.

(8.) $964.29 ÷ .9795 = $984.48, the amount for which he must sell it to gain $100; $984.48 ÷ 3286 = $.30 nearly; $864.29 × .05 = $43.21.

$907.50 ÷ .9795 = $926.49, the amount for which he must sell it to gain 5 per cent.; $926.49 ÷ 3286 = $.282.

(9.) $1800 × .01¾ = $31.50; $31.50 + $1 = $32.50.

(10.) $.60 must be $\frac{90}{110} = \frac{9}{11}$ of the price in order to *gain* 10 per cent.

$\frac{11}{9}$ of $.60 = $.73⅓; $.60 × $\frac{23}{15}$ = $.76⅔; $.60 × $\frac{5}{4}$ = $.75.

(11.) $4500 + $250 + $40 = $4790. Interest at 7 per cent., $27.94. The amount of the cost at the time of sale is $4817.94. Sold for $5250; discount $107.625 + $17.937 = $125.56; $5250 − $125.56 = $5124.44, proceeds of the note. $5124.44 − $4817.94 = $306.50 the net gain; $\frac{30650}{481794}$ = .0636 = $6\frac{36}{100}$ per cent.

(12.) 42853 × .15 = 6428 lb. tare. 42853 − 6428 = 36425 lb. net.

Cost $3187.19. $3187.19 − discount $79.68 = $3107.51 cash price. $3107.51 ÷ 364.25 = $8.53.

(13.) $3107.51 × .05 = $155.38; $3262.89 ÷ 364.25 = $8.96.

(14.) 13,975 lb. − tare 279½ lb. = 13,695½ lb. net.

$8.75 × 136.95½ = $1198.36; 4 per cent. of which is $47.93. $1198.36 − $47.93 = $1150.43.

(15.) The net weight is 226 lb., 350 lb. and 602½ lb. The amount of sales $57.63, $87.50, and $144.60 = $289.73. Com. $7.24. $289.73 − $9.74 = $279.99.

(16.) $279.99 − $1.40 = $278.59.

(17.) 26,987 ÷ 2000 = 13.4935; $187.50 × 13.4935 = $2,530.03; $2,530.03 − discount $88.55 = $2441.48.

26,987 ÷ 2240 = $12\frac{107}{2240}$; $187.50 × $12\frac{107}{2240}$ = $2,258.96.

$2,258.96 − discount $79.06 = $2179.90.

(18.) $2,530.03 − discount $69.15 = $2,460.88.

$2,258.96 − discount $61.75 = $2,197.21.

(19.) $500.783 \times \frac{40}{9} \times \frac{109\frac{1}{2}}{100} = \$2437.14.$

$500.783 \times \frac{40}{9} \times \frac{108\frac{1}{2}}{100} = \$2,414.89.$

$500.783 \times \frac{40}{9} \times \frac{108\frac{3}{4}}{100} = \$2420.45.$

$500.783 \times \frac{40}{9} \times \frac{109\frac{5}{8}}{100} = \$2439.93.$

(20.) $1000 \times \frac{9}{4\emptyset} \times \frac{10\emptyset}{108\frac{1}{3}} = £207.373 = £207\ 7s.\ 5\frac{1}{2}d.$

$1000 \times \frac{9}{4\emptyset} \times \frac{10\emptyset}{107\frac{3}{4}} = £208.817 = £208\ 16s.\ 4d.$

$1000 \times \frac{9}{4\emptyset} \times \frac{10\emptyset}{109\frac{1}{4}} = £205.95 = £205\ 19s.$

$1000 \times \frac{9}{4\emptyset} \times \frac{1\emptyset\emptyset}{11\emptyset} = £204.545 = £204\ 10s.\ 10\frac{1}{2}d.$

(21.) The time the note has to run is 2 mo. 19 da. $\$500 \times .01 \times 2\frac{19}{30} = \$13.17$, discount at 1 per cent. per month; $\$500 - \$13.17 = 486.83$.

$\$500 \times .01\frac{1}{4} \times 2\frac{19}{30} = \$16.46$, discount at $1\frac{1}{4}$ per cent. per month; $\$500 - \$16.46 = \$483.54$.

$\$500 \times .01\frac{3}{4} \times 2\frac{19}{30} = \$23.04$, discount at $1\frac{3}{4}$ per cent. per month; $\$500 - \$23.04 = \$476.96$.

$\$500 \times .02 \times 2\frac{19}{30} = \$26.33$ discount, at 2 per cent. per month; $\$500 - \$26.33 = \$473.67$.

(22.) Pork, $\$341.55 \times 2$ mo. $= 683.1$
Beef, 222.94×2 mo. $= 445.88$
Bacon, 126.00×3 mo. $= 378.00$

690.49)1506.98(2 mo. $5\frac{1}{2}$ da., the equated time.

Discount on $690.49 for 2 mo. $5\frac{1}{2}$ da., at 9 per cent., is $11.30.

By the other method, which is the easier,

The discount on $564.49 for 2 mo. is $8.47
" " " 126.00 " 3 mo. is 2.83
} = $11.30.

(23.) Corn, 85.00×2 mo. $= 170.00$ disc. $1.42
Wh't, 225.00×2 mo. $= 450.00$ " 3.75
Potat's, 72.00×3 mo. $= 216.00$ " 1.80
Pork, 84.08×4 mo. $= 336.32$ " 2.80
} = $9.77

466.08)1172.32(2 mo. $15\frac{1}{2}$ da., the equated time.

Disc. on $466.08 for 2 mo. $15\frac{1}{2}$ da., at 10 per cent., = $9.77.

(24.) St. Louis, April 3, 1849.

Thomas Williams,

Bought of Theodore Smith.

27 casks Bacon,	@	$10.50,	$283.50
10 bbls. Beef,	@	7.00,	70.00
18 bbls. Lard,	@	10.00,	180.00
250 bbls. Flour,	@	3.25,	812.50
			$1346.00
Discount for cash at 5½ per cent.,			74.03
			$1271.97

Received payment,

Theodore Smith, by

Joseph R. Frost.

(25.) Boston, March 1, 1849.

Joseph Johnson,

Bought of William Daniels.

3 hhds. Havana Sugar, 3840 lb.,	@	5½ cents,	$211.20
6 bags Java Coffee, 720 lb.,	@	12½ cents,	90.00
10 casks Raisins,	@	$9.75,	97.50
5 chests Y. H. Tea, 450 lb.,	@	65 cents,	292.50
			$691.20

Received payment,

William Daniels.

$691.20 Boston, March 1, 1849.

Six months from date, I promise to pay William Daniels, or order, six hundred and ninety-one dollars and $\frac{20}{100}$, for value received.

Joseph Johnson.

$691.20 — disc. $21.08 = $670.12, net proceeds of the note.

(26.)

$175.00	× 00 da. =	——
199.75	× 00 da. =	——
56.00	× 10 da. =	560.00
10.67	× 17 da. =	181.39
52.85, 31.09, 218.25	× 35 da. =	10576.65
743.61		)11318.04 (15 da. after Sept.

28, or Oct. 13, the equated time.

$743.61 Boston, Oct. 13, 1848.

Four months from date, I promise to pay James Merchant, or order, seven hundred and forty-three dollars, and $\frac{61}{100}$, for value received.

Samuel Taylor.

Amount of $743.61 from Feb. 16th to March 25th, 1 mo. 9 da.,	$6.44 +	$743.61 =	$750.05
Amount of $145 from Oct. 28th to March 25th, 4 mo. 25 da.,	4.67 +	145.00 =	149.67
Amount of $75 from Nov. 20th to March 25th, 4 mo. 5 da.,	2.08 +	75.00 =	77.08
Amount of $200 from January 10th to March 25th, 2 mo. 15 da.,	3.33 +	200.00 =	203.33
Amount of $75 from March 12th to March 25th, 13 da.,	.22 +	75.00 =	75.22
			$505.30

$750.05 — $505.30 = $244.75 due March 25th.

124b. (3.) . . 3000 gal. at 18 cents; after keeping it 2 months, sold it at 20½ cents; . . a note one half payable in 3 months, the remainder in 6 months. Required the gain or loss, reckoning interest and discount at 7 per cent. per annum.

Ans. $598.51 — $546.30 = $52.21.

(12.) . . gross 50,050 lb. . . tare 12½ per cent. . . $5.50 per 100 lb., less 3¾ per cent. for cash?

Ans. $2318.34; $5.29 per 100 lb.

(13.) . . to gain 10 per cent.?

Ans. $5.82 per 100 lbs.

(14.) . . gross 12,550 lb. . . tare 2¼ per cent., 9½ cents per lb. . . less 4 per cent. for cash? Ans. $1089.39.

(15.) . . 2 bbls. 248 lb., tare 43 lb. at 28½ cents, 5 do. 750 lb. tare 117 lb. at 28 cents . . com. 2½ per cent.; other charges, $3.25? Ans. $226.52½.

(16.) . . 60 days . . exchange ¾ per cent.?

Ans. $222.44.

(17.) . . 25,075 lb. $175 . . 2000 lb., less 2¾ per cent. for cash? 2240 lb.? Ans. $2133.72; $1905.106.

(18.) . . 3 months, 7 per cent.?

Ans. $2154.38; $1923.56.

(19.) . . £300 15s. 8d., premium 9½ per cent.?

Ans. $1463.81.

(20.) . . $500.75 . . premium $8\frac{3}{4}$ per cent.?
Ans. £103 12s. $0\frac{3}{4}$d.

(21.) Date New York, Oct. 25, 1849, . . $500 4 months, discount Nov. 17th, at $1\frac{1}{4}$ per cent. per month?
Ans. $478.96.

125a. (5.) $\frac{50\times10}{25}$ = 20 days *after* February 4th = Feb. 24th.

(6.) $\frac{75\times10}{25}$ = 30 days *before* Feb. 4th = Jan. 5th.

(7.) $\frac{1000\times31}{200}$ = 155 days before April 1st = Oct. 28, 1848.
$\frac{800\times30}{200}$ = 120 days after May 1st = Aug. 29, 1849.

(8.) $\frac{2100\,50.75\times66}{4468.25}$ = 148 days *previous* to Sept. 12th, or April 17th.
$\frac{5582.50\times26}{4468.25}$ = 32 days *after* Oct. 8th, or Nov. 9th.

(9.) The Dr. items fall due Sept. 16th, May 27th, Sept. 12th, and July 1st.

From May 27 to Sept. 16, 112 da. × 300 = 33600
" " " May 27, 000 da. × 250 = ——
" " " Sept. 12, 108 da. × 175 = 18900
" " " July 1, 35 da. × 200 = 7000

925)59500(64 days after May 27, or July 30, the equated time of the Dr. items.

From June 1 to June 1, 00 da. × 200 = ——
" " " June 25, 24 da. × 300 = 7200
" " " July 18, 47 da. × 250 = 11750

750)18950(25 da. after June 1, or June 26, the equated time of the Cr. items.
$\frac{750\times24}{175}$ = 146 days after July 30th, or Dec. 23d.

(10.) The Dr. items become due Dec. 1, April 24, July 27, and Dec. 15.

From April 24 to Dec. 1, 221 da. × 500 = 110500
" " " April 24, 000 da. × 350 = ——
" " " July 27, 94 da. × 75 = 7050
" " " Dec. 15, 235 da. × 180 = 42300

1105)159850(145 da. after April 24, or Sept. 16, the equated time of the Dr. items.

From July 15 to July 15, 00 da. × 400 = ——
" " " " July 23, 8 da. × 300 = 2400
" " " " Oct. 15, 92 da. × 150 = 13800

850)16200(19 da. from July 15, or Aug. 3, 1848, the equated time of the Cr. items.

$\frac{850 \times 44}{255} = 147$ days after Sept. 16th, or Feb. 10th, 1849.

(11.) Am't of $300 from Sept. 16, to Jan. 1, (3 mo. 16 da.) = $305.30
" " 250 " May 27, " " (7 mo. 5 da.) = 258.96
" " 175 " Sept. 12, " " (3 mo. 20 da.) = 178.21
" " 200 " July 1, " " (6 mo.) = 206.00

$948.47

Amount of $200 from June 1, to Jan. 1, (7 mo.) $207.00
" " 300 " June 25, to Jan. 1, (6 mo. 7 da.) 309.35
" " 250 " July 18, to July 1, (5 mo. 14 da.) 256.83

$773.18

$948.47 — 773.18 = $175.29, balance due Jan. 1, 1849. Or,
$175 × .001¼ = $.26 = the interest on $175 for 9 da., which makes the balance due Jan. 1, $175.26.

(12.) Am't of $500 from Dec. 1, to Jan. 1, (1 mo.) $503.33
" " 350 " April 24, " " (8 mo. 8 da.) 369.29
" " 75 " July 27, " " (5 mo. 5 da.) 77.58
" " 180 " Dec. 15, " " (17 da.) 180.68

Amount of Dr. items to Jan. 1, 1130.88

Am'nt of $400 from July 15, to Jan. 1, (5 mo. 17 da.) $414.84
" " 300 " July 23, " " (5 mo. 9 da.) 310.60
" " 150 " Oct. 15, " " (2 mo. 17 da.) 152.57

Amount of Cr. items, 878.01

$1130.88 — $878.01 = $252.87, balance due Jan. 1.
$255 × .006½ = $1.66, disc. from Jan. 1st to Feb. 10th; $255 — $2.21 = 252.79, balance due Jan. 1, by this method; making a difference of seven cents.

13. *Form of an Account Current and Interest Account.*

William Stevens in account current with Stephen Williams.

Interest Account to Sept. 1, 1848.

Dr. *Cr.*

1848.		Time. m.	Time. d.	Interest. $	Interest. cts.	Amount. $	Amount. cts.	1848.		Time. m.	Time. d.	Interest. $	Interest. cts.	Amount. $	Amount. cts.
May 5,	To corn, due June 5th,		88	7	33	500	00	Apr. 6,	By bill of mdse., due Apr. 20,		134	6	70	300	00
" 10,	" butter, due July 20,		43		72	100	00	May 20,	" W. F.'s note, due Oct. 15,	*	44	1	10	150	00
June 17,	" flour, due June 20,		73	7	30	600	00	June 20,	" cash,		73	4	87	400	00
	" Interest on Cr. side in red,	—	—	1	10	—	—		" balance of int. to Dr. side,	—	—	4	88	—	—
	" Balance of interest acct.,	—	—	—	—	4	88		" balance of account,	—	—	—	—	354	88
				$16	45	1204	88					$16	45	1204	88
1848. Sept. 1,	To balance due this day,					354	88								

Errors and omissions excepted.

Boston, Sept. 1, 1848.

STEPHEN WILLIAMS,
By W. F. Hodges.

* To be written with red ink.

14. John Smith in account current with H. Brown.

Interest Account to July 1, 1848.

Dr. *Cr.*

1848.		Time. m.	Time. d.	Interest. $	Interest. cts.	Amount. $	Amount. cts.	1848.		Time. m.	Time. d.	Int'st. $	Int'st. cts.	Amount. $	Amount. cts.	
Jan. 1,	To J. P.'s note, dated Jan. 1, in 4 m.,		58	24	17	2,500	00	Mar. 15,	By ¼ net proceeds brig Edward's cargo, due May 1, 1848,		61	48	30	4,750	50	
Mar. 10,	" bill of merchandize, due 15th March,		108	22	68	1,260	10	Apr. 10,	" net sales coffee, due June 6, 1848,		25	8	96	2,150	50	
Apr. 18,	" T. L.'s note, dated April 1, in 9 m.,	*	187	26	77	859	06	June 1,	" net sales pepper, due Aug. 15, 1848,	*	45	11	30	1,506	90	
May 5,	" paid your order in favor of S. M.,		57	9	50	1,000	00		" Cr. int. on Dr. side in red,		–	26	77	–	–	
June 20,	" cash per receipt,		11	3	30	1,800	00		" balance of int. acct.,	–	–	–	–	13	08	
	" Dr. int. in *red* on Cr. side,		–	11	30	–	–									
	" balance of int. to Cr.,	–	–	13	08	–	–					$	84	03	8,420	98
	" balance of account,	–	–	–	–	1,001	82	1848. July 1,	By bal. due this day, ...					1,001	82	
				$	84	03	8,420	98								

Errors and omissions excepted.

Salem, July 1, 1848.

H. B.

* To be written with red ink.

126a. $\frac{4}{5} \div \frac{5}{12} = \frac{4}{5} \times \frac{12}{5} = \frac{16}{15}$; $\frac{2}{3}$ of $\frac{6}{7} \div \frac{5}{9} = \frac{4}{7} \times \frac{9}{5} = \frac{36}{35}$; $\frac{4}{5} \div 7 = \frac{4}{35}$; $\frac{9}{15} \div 3\frac{1}{3} = \frac{3}{5} \times \frac{3}{10} = \frac{9}{50}$; $4\frac{1}{8} \div 7\frac{3}{8} = \frac{21}{5} \times \frac{8}{59} = \frac{168}{295}$.

126b. (4.) . . $\frac{3}{5}$ to $\frac{4}{15} = \frac{9}{4}$; $4\frac{1}{8}$ to $3\frac{3}{4} = \frac{8}{9}$; $\frac{4}{9}$ to $15 = \frac{4}{135}$.

127a. (1.) $\frac{7 \times 9}{1} = 63$; $\frac{9 \times 48}{3} = 128$; $\frac{12 \times 8}{5} = 19\frac{1}{5}$; $\frac{15 \times 12}{4} = 45$; $\frac{3 \times 8}{5} = 4\frac{4}{5}$; $\frac{15 \times 27}{18} = \frac{45}{2} = 22\frac{1}{2}$; $\frac{80 \times 85}{150} = \frac{136}{3} = 50\frac{2}{3}$.

(2.) $\frac{4 \times \frac{3}{5}}{\frac{3}{8}} = \frac{4}{1} \times \frac{3}{5} \times \frac{8}{3} = \frac{32}{5} = 6\frac{2}{5}$.

$\frac{20 \times 7\frac{1}{2}}{3\frac{1}{8}} = \frac{20}{1} \times \frac{15}{2} \times \frac{8}{25} = \frac{48}{1}$.

$\frac{18\frac{1}{3} \times 25\frac{1}{3}}{15\frac{1}{3}} = \frac{55}{3} \times \frac{76}{3} \times \frac{3}{46} = \frac{209}{69} = 3\frac{2}{69}$.

$\frac{\frac{7}{8} \times \frac{9}{16}}{\frac{4}{5}} = \frac{7}{8} \times \frac{9}{16} \times \frac{5}{4} = \frac{315}{512}$.

(3.) $\frac{5.03 \times 12}{4.7} = \frac{60.36}{4.7} = 12\frac{188}{235}$; $\frac{3.9 \times .5}{2.5} = \frac{3.9 \times .1}{.5} = \frac{.39}{.50} = \frac{13}{25}$.

$\frac{15 \times 1.3}{.7} = \frac{19.5}{.7} = 27\frac{6}{7}$; $\frac{1.8 \times 1.5}{\frac{3}{5}} = \frac{2.7}{.6} = \frac{9}{2} = 4\frac{1}{2}$.

(4.) $\frac{8 \times 15}{7} = 6\frac{3}{7}$; $\frac{25 \times 1.3}{16} = \frac{32.5}{16} = \frac{325}{160} = \frac{65}{32} = 1\frac{33}{32}$.
$\frac{7.5 \times 3.9}{1.3} = \frac{29.25}{1.3} = \frac{2925}{13} = 219\frac{3}{13}$.

(5.) $\frac{5.1 \times 5\frac{3}{8}}{9} = \frac{5.1 \times \frac{5}{8}.375}{} = \frac{27.4125}{8} = \frac{274125}{80000} = \frac{7821}{2240}$ $3\frac{141}{2240}$.

$\frac{3.01 \times \frac{4}{5}}{\frac{7}{8}} = \frac{301}{100} \times \frac{4}{5} \times \frac{8}{7} = \frac{344}{225} = 1\frac{119}{225}$.

$\frac{4\frac{5}{8} \times 5\frac{3}{16}}{6.5} = \frac{45}{8} \times \frac{83}{16} \times \frac{2}{13} = \frac{3735}{832} = 4\frac{407}{832}$.

(6.) $\frac{5 \times 18}{25} = \frac{18}{5} = 3\frac{3}{5}$; $\frac{7.5 \times 15\frac{3}{7}}{18} = \frac{15}{2} \times \frac{108}{7} \times \frac{1}{18} = \frac{45}{7} = 6\frac{3}{7}$.

$\frac{13 \times 5}{9} = \frac{11}{8} \times \frac{5}{1} \times \frac{1}{6} = \frac{55}{72}$.

(7.) $\frac{8 \times 15}{3} = 40$; $\frac{11 \times 25}{6} = 45\frac{5}{6}$; $\frac{5 \times 15}{64} = \frac{75}{64} = 1\frac{11}{64}$.

(8.) $\frac{39 \times 2.5}{16} = \frac{97.5}{160} = \frac{1953}{32} = 6\frac{1}{32}$; $\frac{12 \times 12.5}{14} = \frac{2375}{140} = 16\frac{27}{28}$.

(9.) $\frac{\frac{4}{7}\times\frac{3}{5}}{\frac{2}{3}} = \frac{4}{7}\times\frac{3}{5}\times\frac{3}{2} = \frac{18}{35}$.

$\frac{1\frac{8}{5}\times 1\frac{7}{12}}{\frac{5}{8}} = \frac{18}{5}\times\frac{17}{12}\times\frac{8}{5} = \frac{204}{25} = 8\frac{4}{25}$.

$\frac{\frac{3}{8}\times 1\frac{1}{4}}{\frac{3}{8}} = \frac{3}{8}\times\frac{5}{4}\times\frac{8}{3} = 1\frac{35}{96}$.

127b. Other examples to exercise the pupil in this article can be taken from Art. 128a.

128a. The pupil should give a reason for every statement by this rule. See example 1.

(3.) 8 A. : 360 A. = \$98.50, or by cancellation 1 A. : 45 A. = \$98.50 : \$4432.50.

(4.) 54 A. : 9 A. = \$2160, or 6 A. : 1 A. = \$2160 : \$360.

(5.) 5 men : 7 men = 25 da., or by cancelling, 1 : 7 = 5 : 35.

(6.) 7 men : 5 men = 35 da., or 1 : 5 = 5 : 25 da.

(7.) 25 da. : 35 da. = 5 men, or 5 : 35 = 1 : 7 men.

(8.) \$24.50 : \$94.50 = 7 pairs : 27 pairs.

(9.) 7 pr. : 27 pr. = \$24.50, or 1 : 27 = \$3.50 : \$94.50.

(10.) $\frac{3}{7}$ bbl. : 17 bbls. = \$2.70, or 1 : 119 = \$.90 : \$107.10.

(11.) \$107.10 : \$2.70 = 17 bbl., or 119 : 3 = 17 : $\frac{3}{7}$ bbl.

(12.) $\frac{3}{4}$ yd. : $\frac{7}{8}$ yd. = 10 yd., or 6 : 7 = 10 : $11\frac{2}{3}$ yds.

(13.) 1 cu. ft. : 75 cu. ft. = 1000 oz. : 75,000 oz. = 4,687½ lb.

1 cu. ft. : $189\frac{1}{2}$ cu. ft. = 1000 oz. : 189500 oz.

(14.) 6 per cent. : 5 per cent. = \$125.15 : \$104.29$\frac{1}{6}$.

(15.) \$52.95 : \$61.77½ = 6 per cent. : 7 per cent.

(16.) $7\frac{1}{2}$ per cent. : 24 per cent. = 1 yr. : $3\frac{1}{5}$ yrs.

(17.) $7\frac{1}{2}$ ft. : 187½ ft. = $6\frac{1}{2}$ ft. : $162\frac{1}{15}$ ft.; $6\frac{1}{2}$ ft. : 60 ft. = $7\frac{1}{2}$: $69\frac{3}{13}$ ft.

(18.) 48 yd. : 27 yd. = £33 12s., or 1 : 9 = 42 : 378s. = £18 18s.

(20.) $\frac{3}{8}$: $\frac{7}{16}$ = 24, or 6 : 7 = 24 : 28.

(21.) $3\frac{3}{4}$ lb. : $15\frac{1}{2}$ lb. = 38 : Ans.

$\frac{31}{2}\times\frac{38}{1}\times\frac{4}{15} = \frac{2356}{15} = 157\frac{1}{15}$.

(22.) $33\frac{3}{7}$ A. : $28\frac{3}{4}$ A. = 18, or $1\frac{64}{7}$: $1\frac{15}{4}$ = 18 : Ans.

$\frac{11\cdot 8}{4}\times\frac{18}{1}\times\frac{7}{231} = \frac{805}{52} = 15\frac{25}{52}$.

(23.) $1\frac{1}{4}$ yd. : $3\frac{5}{8}$ yd. = $5\frac{3}{8}$: Ans.

$\frac{29}{8}\times\frac{43}{8}\times\frac{4}{5} = \frac{1247}{80} = 15\frac{47}{80}$.

(24.) 9 h. : 10 h. = 3 da. : $3\frac{1}{3}$ da.

128b. Examples to exercise the pupil in this article may be taken from Art. 123.

129a. (1.) Cancel equal factors before multiplying.

$$\left.\begin{matrix} 3\not{6} : 5 \\ 3 : \not{8} \\ \not{4} : 5 \end{matrix}\right\} = \left.\begin{matrix} 3\frac{1}{2} : 8 \\ 2\frac{1}{4} : 7 \\ 3 : 4\frac{1}{4} \end{matrix}\right\} = \left.\begin{matrix} \frac{7}{2} : 8 \\ \frac{9}{4} : 7 \\ \frac{3}{4} : \frac{17}{4} \end{matrix}\right\} = \left.\begin{matrix} \frac{1}{2} : 8 \\ 9 : 1 \\ 3 : 17 \end{matrix}\right\} = \frac{27}{2} : 136 = 27 : 272.$$

$$\left.\begin{matrix} 4 : 3\frac{1}{4} \\ 4\frac{1}{2} : 3 \\ 8 : 9 \end{matrix}\right\} = \left.\begin{matrix} 4 : \frac{13}{4} \\ \frac{13}{3} : 3 \\ 8 : 9 \end{matrix}\right\} = \left.\begin{matrix} 4 : \frac{1}{3} \\ \frac{1}{3} : 3 \\ 8 : 9 \end{matrix}\right\} = \frac{32}{3} : \frac{27}{4} = \frac{128}{12} : \frac{81}{12}.$$

129b. Additional exercises may be taken from Art. 130a.

130a. (1.) $\left.\begin{matrix} 4 : 13 \\ 3 : 7 \end{matrix}\right\} = 5 : —.$ $\left.\begin{matrix} \not{6} : \not{5} \\ \not{15} : \not{12}\,2 \end{matrix}\right\} = \frac{4}{12} : —.$

$12 : 91 = 5 : 37\frac{11}{13}.$ $1 : 2 = 4 : 8.$

(2.) $\left.\begin{matrix} \frac{1}{2} : \frac{3}{5} \\ 5 : 7 \end{matrix}\right\} = 8 : —$

$\frac{1}{2} : \frac{21}{5} = 8 : 13\frac{11}{21}.$

$$\left.\begin{matrix} 4\frac{1}{2} : 6\frac{1}{2} \\ 5 : 8\frac{1}{4} \\ 4 : 5 \end{matrix}\right\} = \left.\begin{matrix} \frac{9}{2} : \frac{13}{2} \\ 5 : \frac{33}{4} \\ 4 : 5 \end{matrix}\right\} = \left.\begin{matrix} 3 : 13 \\ 1 : \frac{11}{4} \\ 4 : 1 \end{matrix}\right\} = \left\{\begin{matrix} 12 : \frac{143}{4} = \frac{13}{4} \\ \text{or} \\ 192 : 143 = 13 \end{matrix}\right\} : 91\frac{31}{192}$$

$$\left.\begin{matrix} \frac{3}{5} : \not{8}\,2 \\ \not{2} \cdot \not{5} \\ \not{10} : \not{9}\,3 \end{matrix}\right\} = 4 : —.$$

$1 : 6 = 4 : 24$

$$\left.\begin{matrix} 1 : \frac{3}{\not{6}} \\ \frac{3}{\not{3}} : \frac{2}{\not{6}} \\ \frac{3}{\not{6}} : \frac{2}{\not{3}} \end{matrix}\right\} = \frac{3}{4} : —$$

$1 : 2 = \frac{3}{4} : 1\frac{1}{2}$

(5.) $\left.\begin{matrix} 2\not{0} \text{ men} : \not{14} \text{ men} \\ \not{84} \text{ rd.} : \not{300} \text{ rd.} \end{matrix}\right\} = 3 \text{ da.} : —$

$2 : 5 = 3 \text{ days} : 7\frac{1}{2} \text{ days.}$

(6.) $\left.\begin{matrix} \not{24} \text{ horses} : 32 \text{ horses} \\ \not{36} \text{ days} : \not{48} \text{ days} \end{matrix}\right\} = \frac{7}{\not{12}\not{6}} \text{ bushels} : —.$

$1 : 32 = 7 : 224 \text{ bushels.}$

(7.)

$$\left.\begin{array}{l} 12 \text{ men} : 4 \text{ men} \\ 10 \text{ feet} : 10 \text{ ft.} \\ 6 \text{ feet} : 4\,8 \text{ ft.} \\ 2 \text{ feet} : 3 \text{ feet} \end{array}\right\} = \overset{1}{6}\text{da.} : —.$$

$$1 : 40 = 1 : 40 \text{ da.}$$

(9.)

$$\left.\begin{array}{l} 35 \text{ men} : 7 \text{ men} \\ 12 \text{ h.} : 9 \text{ h.} \\ 210 \text{ ft.} : 420 \text{ ft.} \\ 3 \text{ ft.} : 4 \text{ ft.} \\ 4 \text{ ft.} : 5 \text{ ft.} \end{array}\right\} = \overset{2}{4}\text{da.} : —.$$

$$1 : 1 = 2 \text{ da.} : 2 \text{ da.}$$

(8.)

$$\left.\begin{array}{l} \$200 : \$500 \\ 12 \text{ mo.} : 4\,8 \text{ mo.} \end{array}\right\} = \$\,\overset{1}{12} : —$$

$$1 : 20 = 1 : 20$$

(10.)

$$\left.\begin{array}{l} 9 \text{ men} : 4 \text{ men} \\ 38\frac{1}{4} \text{ rods} : 123\frac{1}{2}\frac{1}{6} \end{array}\right\} = 3\tfrac{1}{4} \text{ days} : —.$$

$$344\tfrac{1}{4} : 494\tfrac{4}{13} = 3\tfrac{1}{4} : 4\tfrac{1}{3} \text{ or,}$$

$$\tfrac{4}{1}\tfrac{3}{3}\tfrac{2}{2} \times \tfrac{1}{4}^{2} \times \tfrac{4}{13\,77} = \tfrac{1}{3} = 4\tfrac{1}{3} \text{ days.}$$

(11.)

$$\left.\begin{array}{l} 12 \text{ hours} : 10 \text{ hours} \\ 40 \text{ days} : 25 \text{ days} \\ 175 \text{ rods} : 4\,44\,8 \text{ rods} \end{array}\right\} = \overset{25}{75} \text{ men} : —.$$

$$1 : 4 = 25 : 100 \text{ men.}$$

(12.)

$$\left.\begin{array}{l} 10 \text{ boxes} : 15 \text{ boxes} \\ 7\,420 \text{ pounds} : 450 \text{ pounds} \\ 15 \text{ miles} : 60 \text{ miles} \end{array}\right\} = \$5 : —.$$

$$7 : 45 = \$5 : \$32\tfrac{1}{7}.$$

(13.)

$$\left.\begin{array}{l} \overset{1}{2} \text{ days} : \overset{3}{6} \text{ days} \\ 5 \text{ eighths} : 3 \text{ eighths} \end{array}\right\} = \overset{3}{15} \text{ men} : —.$$

$$1 : 9 = 3 : 27 \text{ men, or}$$

12 more than 15.

(14.)

$$\left.\begin{array}{l} 12 \text{ hours} : 7\,14 \text{ hours} \\ 69\,276 \text{ miles} : 71\,852 \text{ miles} \end{array}\right\} = \overset{3}{16} \text{ days} : —.$$

$$69 : 497 = 8 : 57\tfrac{1}{3}\tfrac{3}{9} \text{ days.}$$

(15.)

$$\left.\begin{array}{l} 10 \text{ weeks} : 15 \text{ weeks} \\ 12 \text{ ounces} : 3\,18 \text{ ounces} \end{array}\right\} = \overset{25}{500} \text{ men} : —.$$

$$1 : 45 = 25 \text{ men} : 1125 \text{ men.}$$

(16.) $\left.\begin{array}{l} \text{6 feet} : \text{4 feet} \\ \text{3 inches} : \text{2 inches} \\ \text{2 inches} : 1\frac{1}{2} \text{ inch} \end{array}\right\} = 7\frac{1}{2} \text{ pounds} : —.$

$1 : 12 = 2 : 24$ pounds.

(17.) $\left.\begin{array}{l} 324 \text{ men} : 31\,24\text{8 men} \\ 39 \text{ hours} : 11 \text{ hours} \\ 230 \text{ yards} : 7\,420 \text{ yards} \\ 3 \text{ yards} : 5 \text{ yards} \\ 2 \text{ yards} : 3 \text{ yards} \end{array}\right\} = 5 \text{ days} : —.$

$207 : 11935 = 5 : 288\frac{58}{207}.$

(18.) $\left.\begin{array}{l} £1 : £1\,50\,9 \\ 100 \text{ per cent.} : 108\frac{1}{2} \text{ per cent.} \end{array}\right\} = \frac{20}{\frac{40}{9}} : —.$

$1 : 108\frac{1}{2} = 20 : \$2170 :$

$\left.\begin{array}{l} £1 : £1\,50\,9 \\ 100 \text{ per cent.} : 109\frac{1}{4} \text{ per cent.} \end{array}\right\} = \$\frac{20}{\frac{40}{9}} : —.$

$1 : 109\frac{1}{4} : 30 : \$2185.$

(19.) $\left.\begin{array}{l} \$4\frac{4}{9} : \$1000 \\ 108\frac{1}{2} \text{ per cent.} : 100 \text{ per cent.} \end{array}\right\} = £1 : —.$

$\frac{40}{9} \times \frac{2}{21} : 100000 = 1 :$ Ans. Or,
$\frac{100000}{1} \times \frac{9}{2\,17} = £207\frac{8}{217} = £207\ 7s.\ 5\frac{1}{7}d.$

$\left.\begin{array}{l} \$4\frac{4}{9} : \$1000 \\ 109\frac{1}{4} : 100 \end{array}\right\} = £1 : —.$

$\frac{40}{9} \times \frac{437}{4} : 100000 = 1 :$ Ans. Or,
$\frac{100000}{1} \times \frac{8}{437} = £205\ 18s.\ 11\frac{3}{4}d.$

130b. (5.) If 17 men . 102 rd. . 4 da. . . . 30 men, 500 rd.? Ans. $11\frac{1}{3}$ days.

(6.) If 6 horses . 64 bu. 70 da. . . . 21 horses, 45 da.? Ans. 144 bu.

(7.) If 5 men . . 35 ft. long, 7 ft. high, $1\frac{1}{2}$ ft. thick, in 12 days . . 15 men . . 21 ft. long, $10\frac{1}{2}$ ft. high, 3 ft. thick? Ans. $7\frac{1}{2}$ days.

(11.) If 100 men . . 12 hours 30 da. 225 rd. . . 475 rd. 50 da. 10 hours? Ans. 152 men.

(13.) . . 12 da. 24 men . . 10 da., $\frac{2}{5}$ unfinished . . ? Ans. 56 more men.

(16.) . . 4 ft. long 2 in. broad $1\frac{1}{2}$ in. thick, 24 lb. . . 7 ft. long . 3 in. wide $\frac{3}{4}$ in. thick? Ans. $31\frac{1}{2}$ lb.

(18.) . . £500 . . $8\frac{3}{4}$ per cent.? Ans. \$2416.66$\frac{2}{3}$.

(19.) . . \$500 . . $9\frac{1}{4}$ per cent.? Ans. £102 19s. 5.96d.

131a. (3.)

$\frac{6}{8}$ oxen	12 oxen.
$\frac{8}{8}$ days	$2\frac{6}{6}$ days.
—— A.	5 acres.

120 acres.

(4.) Statement.

\$500	\$1020
$3\frac{1}{2}$ yr.	$5\frac{1}{2}$ yr.
\$——	\$105

Solution.

500	1020 51
7	2
2	11
—	105 3

5) 1683(336$\frac{3}{5}$.

(5.) Statement.

6 men.	10 men.
8 days.	— days.
10 hours.	9 hours.
$\frac{7}{8}$	$\frac{3}{4}$

Solution.

2 6	10
8	—
10	9
7	8
4	3

9) 56(6$\frac{2}{9}$.

(6.) Statement.

7 feet.	$10\frac{1}{2}$ feet.
5 feet.	$7\frac{1}{2}$ feet.
6 feet.	9 feet.
—— lb.	13125 lb.

Solution.

2	21
2	15
7	9
5	13125
2 6	125

8) 354,375

44,296$\frac{7}{8}$.

(8.) —— yr. | 1 year.
$500.75 | $100
6.00 | 35.75

3004.5) 3575(1$\frac{1}{1}\frac{4}{0}\frac{4}{0}\frac{1}{3}$ yr.

(9.) $—— | $192.50
100\frac{0}{0}$ | $100
$3\frac{1}{2}$ yr. | 1 year.

35) 192.5 ($5.5.

Statement.

(10.) —— bbl. | 150 bu.
6\frac{7}{8}$ | $$\frac{5}{8}$$

Solution.

—— | 150
11 $\frac{5}{5}$ | $\frac{8}{8}$
$\frac{8}{8}$ | $\frac{5}{5}$

11) 150

$13\frac{7}{11}$.

Statement.

(11.) $5\frac{1}{2}$ feet | —
175 feet | $8\frac{1}{2}$ feet.

Solution.

11 | 2
5 | 44 4
175 | ——

8) 875

$109\frac{3}{8}$ feet.

132a. (2.) 10 barrels flour.
9 bushels wheat.
12 bushels corn.
5 bushels rye.
$50.

54 bushels wheat.
20 bushels corn.
2 10 bushels rye.
$3.50 .07.
—— barrels flour.

.14) 1 ($7\frac{1}{7}$ barrels.

10 barrels flour.
9 bushels wheat.
12 bushels corn.
5 bushels rye.
$——

18 54 bushels wheat.
20 bushels corn.
10 bushels rye.
$3.50.
2 18 barrels.

$126

(3.) 15 oranges.
7 lemons.
9 18 apples.
8 pears.
3 peaches.
— cents.

5 35 lemons.
12 apples.
5 10 pears.
15 peaches.
2 cents.
10 oranges.

9) 250 ($27\frac{7}{9}$ cents.

15 oranges.	5 35 lemons.
7 lemons.	12 apples.
18 apples.	10 pears.
4 8 pears.	15 peaches.
3 peaches.	2 cents.
40 cents.	—— oranges.

5) 72 ($14\frac{2}{5}$ oranges.

(4.)

1	0 4
40	24
20	35
60	1
—	100

140 florins.

(5.)

$1	515 cent.
2580 cent.	£1
£1000	$—

5.15)25800

$5009.71.

Statement.

(6.)

$4\frac{1}{2}$	£1
£1000	$—
$109\frac{1}{2}$	100

Solution.

20 40	3
1000	—
73 219	2
	100

3)14600

$4866.67.

$5009.71 — $4866.67 = $143.04.

133a. (3.) $1550 : $450 = $248 : $72, A's share of the gain.
$1550 : $500 = $248 : $80, B's share of the gain.
$1550 : $600 = $248 : $96, C's share of the gain.

$1550 : $450 = $93 : $27, A's share of the loss.
$1550 : $500 = $93 : $30, B's share of the loss.
$1550 : $600 = $93 : $36, C's share of the loss.

(4.) $980 : $420 = $840 : $360, A's money.
(5.) $7150 : $2288 = $100 : $32, per cent. gain.
$1600 × .32 = $512 = A's gain.
$1800 × .32 = $576 = B's gain.
$2550 × .32 = $816 = C's gain.
$1200 × .32 = 384 = D's gain.

(6.) $20 : $6 = $850 : $255, the share of the first.
$20 : $5 = $850 : $212.50, the share of the second, &c.

By analysis. The first will have $\frac{6}{20} = \frac{3}{10}$ of the whole; the second, $\frac{5}{20} = \frac{1}{4}$, &c.

(7.) $\$1\frac{1}{4} : \frac{3}{4}$ or $5 : 3 = \$75 : \$45$, A's share.
$1\frac{1}{4} : \frac{1}{2}$ or $5 : 2 = \$75 : \$30$, B's share.
By analysis. A must have $\frac{3}{5}$ and B $\frac{2}{5}$ of \$75.

(8.) $\frac{1}{3} + \frac{1}{4} + \frac{3}{8} = \frac{8}{24} + \frac{6}{24} + \frac{9}{24} = \frac{23}{24}$. The shares are as the numbers 8, 6 and 9.
$23 : 8 = \$345 : \$120$, the share of the first.
$23 : 6 = \$345 : \$90$, the share of the second, &c.

By analysis. The first must have $\frac{8}{23}$, the second $\frac{6}{23}$, and the third $\frac{9}{23}$, of \$345.

(9.) $\frac{1}{3} + \frac{2}{5} + \frac{4}{5} + \frac{5}{9} = \frac{15}{45} + \frac{18}{45} + \frac{36}{45} + \frac{25}{45} = \frac{94}{45}$. The shares are to be in the proportion of the numbers 15, 18, 36, and 25.

$94 : 15 = \$750 : \$119.68$, the share of the first.
$94 : 18 = \$750 : \$143.62$, the share of the second, &c.

By analysis. The first must have $\frac{15}{94}$, the second $\frac{18}{94} = \frac{9}{47}$, &c., of \$750.

(10.) $13\frac{1}{2} + 15\frac{5}{7} = \frac{189}{14} + \frac{220}{14} = \frac{409}{14}$. They should pay in the proportion of 189 and 220.
$409 : 189 = \$20 : \$9.24$, A should pay.
$409 : 220 = \$20 : \$10.76$, B should pay.

(11.) $\$12500 : \$500 = \$10000 : \$400$, the answer.

(12.) $\$2550 : \$400 = \$1000 : \$156.86$, A's part of the dividend.
$\$2550 : \$750 = \$1000 : \$294.12$, B's part of the dividend.

133b. (5.) A \$1500, B \$600, C \$750, D \$2000; gain \$1164 . . ?
Gain 24 per cent. A's share, \$360; B's, \$144; C's, \$180; D's, \$480.
(6.) Divide \$1050 . . 4 men . . 4, 5, 6, and 7?
Ans. A \$190.909; B \$238.636; C \$286.363; D \$334.09.
(8.) Divide \$1800 . . 4 men . . $1\frac{1}{2}$, $1\frac{3}{4}$, 2 and $2\frac{1}{4}$?
Ans. \$360; \$420; \$480; \$540.
(10.) . . \$10 . . A's 15 weeks, B's $10\frac{1}{2}$ weeks?
Ans. A's $\$5.93\frac{13}{59}$; B's $\$4.06\frac{46}{59}$.
(12. . . \$1500 . . 3 creditors . . A \$540, B \$762, C \$1075 . . ?
Ans. A's \$340.77; B's \$480.86; C's \$678.38.

134a. (2.) By analysis. Three cows for 8 weeks = 24 cows for 1 week; 5 cows for 7 weeks = 35 cows for 1 week. A must, therefore, pay $\frac{24}{59}$ and B $\frac{35}{59}$ of $50.

By proportion. 59 : 24 = $50 : $20.34, A should pay.
59 : 35 = $50 : $29.66, B " "

(3.) By analysis. 15 men for 16 weeks = 240 men for 1 week.
20 men for 21 weeks = 420 men for 1 week.
30 men for 24 weeks = 720 men for 1 week.
A will, therefore, have $\frac{12}{69}$, B $\frac{21}{69}$, and C $\frac{36}{69}$, of the gain.

By proportion. 1380 : 240 = $1500 : $260.87, A's share.
1380 : 420 = $1500 : $456.52, B's "
1380 : 720 = $1500 : $782.61, C's "

(4.) $1000 for 12 mo. = $12000 for 1 mo.
$1500 for 9 mo. = $13500 for 1 mo.
$800 for 8 mo. = $6400 for 1 mo.
A's share of the gain is $\frac{12}{319}$, B's $\frac{13}{319}$, and C's $\frac{64}{319}$, of $1500.

31900 : 12000 = $1500 : $564.26, A's share of the gain.
31900 : 13500 = $1500 : $634.80, B's share of the gain.
31900 : 6400 = $1500 : $300.94, C's share of the gain.

(5.) $2000 for 12 mo. = 24000 for 1 mo.
$500 for 9 mo. = 4500 for 1 mo.
$600 for 8 mo. = $4800 for 1 mo.; and 800 for 8 mo. = $6400 for 1 mo.
$1000 for 5 mo. = $5000 for 1 mo.; and $900 for 5 mo. = $4500 for 1 mo.

A's amount is, therefore, 24000 − 4500 + 4500 = 24000.
B's amount is, therefore, 24000 − 4800 = 19200.
C's amount is, therefore, 24000 + 6400 − 5000 = 25400.
68600.

68600 : 24000 = $2500 : $874.64, A's share of the gain.
68600 : 19200 = $2500 : $699.71, B's share of the gain.
68600 : 25400 = $2500 : $925.66, C's share of the gain.

(6.) 25 men for $3\frac{1}{2}$ mo. = $87\frac{1}{2}$ men for 1 mo.
35 men for $2\frac{3}{4}$ mo. = $96\frac{1}{4}$ men for 1 mo.
40 men for $3\frac{1}{4}$ mo. = 130 men for 1 mo.

Their losses, therefore, are as the numbers $87\frac{1}{2}$, $96\frac{1}{4}$, and 130; or, reducing these numbers to 4ths, and dividing by 5, as the numbers 70, 77, and 104.

251 : 70 = \$875 : \$244.02, A's share of the loss.
251 : 77 = \$875 : \$268.43, B's share of the loss.
251 : 104 = \$875 : \$362.55, C's share of the loss.

134b. (2.) . . \$30, A 3 cows for 7 weeks, B 1 for 8 weeks, C 2 for 5 weeks?

Ans. A's $\$16.15\frac{5}{13}$; B's $\$6.15\frac{5}{13}$; C's $\$7.69\frac{3}{13}$.

(3.) 3 persons . . A 12 men for 8 weeks, B 15 men for 9 weeks, C 25 men for 10 weeks; gain \$500 . . ?

Ans. A's \$99.79; B's \$140.33; C's \$259.88.

(5.) Jan. 1, 1849, . . each \$1200 . May 1st, A withdraws \$500, and B adds \$200; July 1st, B withdraws \$300, and C adds \$500; Oct. 1st, A adds \$600, and C withdraws \$300. Gain \$1500. . . ?

Ans. A $\$426.57\frac{147}{425}$; B $\$496.50\frac{159}{425}$; C $\$576.92\frac{132}{425}$.

135a. (1.) The distances travelled on the several days are as the numbers 1, 2, and 6. He, therefore, travelled $\frac{1}{9}$ of the whole distance the first day, $\frac{2}{9}$ the second, and $\frac{6}{9}$ or $\frac{2}{3}$ the third.

(2.) The parts are as the numbers 1, 3, and 15. The first part is $\frac{1}{19}$, the second $\frac{3}{19}$, and the third $\frac{15}{19}$, of the whole.

(3.) The sums contributed are as the numbers 1, $2\frac{1}{4}$, and $3\frac{1}{4}$, or as 2, 5, and 7. A, therefore, contributed $\frac{2}{14}$ or $\frac{1}{7}$, B $\frac{5}{14}$, and C $\frac{1}{2}$, of \$4200.

(4.) Their cost was in the proportion of 1 to 4. The horse cost $\frac{1}{5}$, and the carriage $\frac{4}{5}$, of \$600.

(5.) The daily wages of 1 man and 1 boy were \$1.25; there were, therefore, as many of each as there are times \$1.25 in \$11.25, or 9 of each.

(6.) The daily wages of 1 man and 3 boys were \$2.15; their weekly wages, \$12.90. There were, therefore, as many men and 3 times as many boys as there are times \$12.90 in \$103.20, or 8 men and 24 boys.

(7.) The numbers hired were as the numbers 6, 4, and 3. 6 men at \$1 per day, 4 men at 75 cents, and 3 men at 50 cents, would earn \$10.50 per day. There were, therefore, 6 times as many men hired at \$1, 4 times as many at 75 cents,

and 3 times as many at 50 cents, as there are times \$10.50 in \$21, or 12, 8 and 6.

(8.) Each man ate $2\frac{2}{3}$ loaves; consequently A furnished C $2\frac{1}{3}$ loaves, and B furnished him $\frac{1}{3}$ of a loaf. They should share C's money in the proportions of $2\frac{1}{3}$ to $\frac{1}{3}$, or of 7 to 1.

(9.) He earned \$6.25 and forfeited 35 cents per week; his net weekly earnings were, therefore, \$5.90, and he was employed as many weeks as there are times \$5.90 in \$47.20, or 8 weeks.

(10.) Their ages are as the numbers 1 and 5. The father's is $\frac{5}{6}$, and the son's $\frac{1}{6}$, of 42 years.

(11.) Thirty-nine dollars would buy one of each; there were as many of each as there are times 39 in 156, or 4.

(12.) Their numbers were as the numbers 1, 3, and 6. 1 cow, 3 calves, and 6 sheep, would come to \$67.50. There were, therefore, as many cows, 3 times as many calves, and 6 times as many sheep, as there are times \$67.50 in \$337.50, or 5 cows, 15 calves, and 30 sheep.

(13.) The parts are as the numbers 1, 2, $7\frac{1}{2}$, and $10\frac{1}{2}$, or as 2, 4, 15, 21. The first must be $\frac{2}{42} = \frac{1}{21}$, the second $\frac{4}{42} = \frac{2}{21}$, the third $\frac{15}{42} = \frac{5}{14}$, and the fourth $\frac{21}{42} = \frac{1}{2}$, of 336.

Ans. 16, 32, 120, 168.

(14.) The numbers are as the numbers 1 and $7\frac{1}{2}$, or 2 and 15. One is $\frac{2}{17}$ and the other $\frac{15}{17}$ of 204.

(15.) $\frac{3}{5} + \frac{3}{4}$ of $\frac{5}{6} = \frac{27}{32}$. He has spent $\frac{27}{32}$ of his money, and has $\frac{5}{32}$ of it remaining. \$500 is $\frac{5}{32}$ of \$3200.

(16.) The first can fill it twice, the second three times, and the third four times, per hour. They can all fill it nine times per hour, or once in $\frac{1}{9}$ of an hour.

(17.) $\frac{4}{5}$ exceeds $\frac{3}{8}$ by $\frac{9}{40}$; 270 is, therefore, $\frac{9}{40}$ of the number $= 1200$.

(18.) By working $\frac{1}{4}$ of an hour per day, it would take him 38 times $3\frac{1}{2}$ days to perform the work; but if he work $10\frac{3}{4}$ hours per day, it will take him but $\frac{1}{43}$ of 38 times $3\frac{1}{2}$ days, or $\frac{32}{43}$ of $\frac{7}{2}$ days $= \frac{112}{43}$ days $= 3\frac{43}{43}$ days.

(19.) 15 men will mow $\frac{15}{3} = \frac{5}{3}$ of 10 acres in 1 day, and in $3\frac{1}{4}$ days they will mow $\frac{7}{2}$ of $\frac{5}{3}$ of 10 acres $= \frac{175}{3}$ A. $= 58\frac{1}{3}$ A.

(20.) $\frac{978 \times 8\frac{1}{2} \times \frac{8}{9}}{45} = \frac{5544}{45} = 123\frac{7}{15}$ bushels.

135b. (2.) . . 1710 . . 4 parts . . second 4 times the first, the third $1\frac{1}{2}$ times the second, and the fourth $1\frac{1}{3}$ times the third. Ans. 90, 360, 540, 720.

(3.) . . B $3\frac{1}{4}$ times as much as A, and C twice as much as both, . . whole amount being \$612.
Ans. A 48, B 156, C 408.

(5.) . . each boy 30 cents and each man \$1.25 . . amount \$20.15? Ans. 13 of each.

(6.) . . $3\frac{1}{2}$ times as many boys as men, each boy 28 cents, and each man \$1.40 per day, . . weekly wages \$57.12?
Ans. 4 men 14 boys.

(7.) . . a certain number at 75 cts, $\frac{3}{4}$ as many at \$1, and $1\frac{1}{2}$ as many at \$1.25; . . daily wages \$27 . . ?
Ans. 8 at \$.75, 6 at \$1, and 12 at \$1.25.

(8.) . . A 5, B 4, and C 1 loaf and 7 pieces of money . . ?
Ans. A 5 and B 2.

(9.) . . \$1.50 . . wages and 40 cents more . . idle $1\frac{1}{2}$ days per week . . received \$61.20. Ans. 8 weeks.

(10.) . . $3\frac{5}{8}$ his son's . . sum of both $55\frac{1}{2}$ years . . ?
Ans. 12 and $43\frac{1}{2}$ years.

(12.) . . for \$348 . . \$25 for cows, $\$4\frac{1}{4}$ for calves, $\$3\frac{3}{4}$ for sheep . . 4 times as many calves as cows, and 3 times as many sheep as calves . . ?
Ans. 4 cows, 16 calves, 48 sheep.

(13.) . . 1260 into 4 such parts . . second $2\frac{1}{2}$ times the first, the third $1\frac{1}{2}$ times the first and second, and the fourth $1\frac{1}{4}$ times the other three. Ans. 64, 160, 336, 700.

(14.) . . $5\frac{1}{4}$ times the less, sum 1000 . . ?
Ans. 160 and 840.

(15.) . . $\frac{4}{5}$ and $\frac{2}{5}$ of the remainder, had \$200 . . ?
Ans. \$2400.

(17.) $\frac{2}{5}$ exceeds $\frac{2}{7}$. . by 84 . . ? Ans. 735.

(18.) . . $2\frac{1}{4}$ da. . . $10\frac{1}{4}$ h. per day . . $12\frac{1}{2}$ h.?
Ans. $1\frac{168}{200}$ days.

(19.) If 8 men mow 11 A. in 1 day . . 20 men in $4\frac{1}{4}$ da.?
Ans. $116\frac{7}{8}$ days.

136a. (1.) $8\frac{3}{8} : 5\frac{7}{15}$. Reducing the terms to a common denomination they become $\frac{1005}{120}$ and $\frac{848}{120}$. $3\frac{9}{16} : 75\frac{1}{24} = \frac{171}{48} : \frac{3602}{48}$.

(2.) Reducing the terms to hundredths. $\frac{330}{875} = \frac{186}{195}$; $\frac{547}{850}$.

(3.) .87 : .087. Reducing to thousandths, $\frac{870}{87} = \frac{10}{1}$.

.00015 : .19. Reducing to hundred thousandths, $\frac{15}{100000}$ $= \frac{3}{3800}$.

(4.)

$$\left.\begin{array}{l} 2\$: 7 \\ 15 : \cancel{4} \end{array}\right\} \quad \left.\begin{array}{l} 8\frac{3}{5} : 7\frac{1}{4} \\ 15\frac{1}{3} : 4\frac{3}{68} \end{array}\right\} = \left\{\begin{array}{l} \frac{87}{8} : \frac{31}{4} \\ \frac{46}{3} : \frac{89}{22} \end{array}\right\} = \left\{\begin{array}{r} 67 : \$ \\ 46 : 3 \\ \cancel{4} : 31 \\ 11\,\cancel{22} : 89 \end{array}\right.$$

$30 : 7$ $\qquad$ $33902 : 8277.$

(5.)

(6.) $\frac{15}{\cancel{2}} \times \frac{25}{1} \times \frac{\cancel{2}}{17} = \frac{375}{17} = 22\frac{1}{17}$.

By proportion.

(7.) $\left.\begin{array}{l} \cancel{9} \text{ in.} : \cancel{18} \text{ in.} \\ \cancel{2\$} \text{ ft.} : 5\,\cancel{130} \text{ ft.} \\ \cancel{4} \text{ ft.} : 3\,\$ \text{ ft.} \end{array}\right\} = 1000 \text{ bricks} : —.$

$1 : 15 = 1000 : 15000$ bricks.

By cause and effect.

1000	—
$\cancel{18}$	$\cancel{9}$
5 $\cancel{130}$	$\cancel{2\$}$
3 $\$$	$\cancel{4}$

15000 bricks.

(8.) $\left.\begin{array}{l} \cancel{2} \text{ ft.} : 7 \text{ ft.} \\ \cancel{3} \text{ in.} : \cancel{6} \text{ in.} \\ 1 \text{ in.} : 3\frac{1}{2} \text{ in.} \end{array}\right\} = 18 \text{ pounds} : —.$

$1 : 24\frac{1}{2} = 18 \text{ lb.} : 441 \text{ lb.}$

$\cancel{2}$	7
$\cancel{3}$	$\cancel{6}$
1	$3\frac{1}{2}$
— lb.	18 lb.

441 lb.

(9.) $\left.\begin{array}{l} \cancel{40} \text{ yd.} : \overset{6}{\cancel{240}} \text{ yd.} \\ \cancel{4} \text{ ft.} : 3\,\$ \text{ ft.} \\ \cancel{2} \text{ ft.} : 3 \text{ ft.} \\ \cancel{8} \text{ da.} : \cancel{32} \text{ da.} \end{array}\right\} = 7 \text{ men} : —.$

$1 : 54 = 7 \text{ men} : 378 \text{ men.}$

—	7
$\cancel{8}$	$\cancel{32}$
$\cancel{40}$	$\cancel{240}$ 6
$\cancel{4}$	$\$$ 3
$\cancel{2}$	3

378 men.

(10.) $\left.\begin{array}{l} \cancel{1\$} \text{ da.} : 22 \text{ da.} \\ \cancel{21\emptyset} \text{ yd.} : \cancel{23\emptyset} \text{ yd.} \end{array}\right\} = \overset{5}{\cancel{5\emptyset}} \text{ men} : —.$

$1 : 22 = 5 \text{ men} : 110 \text{ men.}$

5 $\cancel{5\emptyset}$	—
22	$\cancel{1\$}$
$\cancel{23\emptyset}$	$\cancel{21\emptyset}$

110 men.

(11.) 20 men for 60 da. = 1200 men for 1 da.
30 men for 50 da. = 1500 men for 1 da.
60 men for 55 da. = 3300 men for 1 da.

Their proportions of the gain, therefore, after deducting $150 for C, are as the numbers 12, 15, and 33, or as 4, 5, and 11.

A's gain is $\frac{4}{20} = \frac{1}{5}$ of $9000; B's $\frac{5}{20} = \frac{1}{4}$ of $9000; and C's $\frac{11}{20}$ of $9000.

(12.) $\frac{3}{10} + \frac{1}{3} = \frac{27}{90} + \frac{40}{90} = \frac{67}{90}$. C's share is, therefore, $\frac{23}{90}$ of the whole, and their shares are as the numbers 27, 40, and 23; and consequently A paid $\frac{27}{23}$, and B $\frac{40}{23}$ of $1150. A $1350; B $2000.

(13.)	10 bbls. flour.	45 bu. wheat.	(14.)	25	22
	15 bu. wheat.	25 bu. corn.		88	92
	24 bu. corn.	20 bu. rye.		2 46	49
	18 bu. rye.	4,25 $12.75		2 98	—
	4 $100	— bbls. flour.			
				100 lb.	

96 ÷ 4.25 = 22$\frac{8}{17}$ bbls.

(15.)

$250 for	6 mo., and $300 for 4 mo.	= $2700 for	1 mo.	= A's.
450 "	8 mo.,	= 3600 "	"	= B's.
800 "	5 mo., " 500 " 4 mo.	= 6000 "	"	= C's.
200 "	7 mo., " 500 " 5 mo.	= 3900 "	"	= D's.
1500 "	10 mo., " 500 " 2 mo., and 300 for 5 mo.,	= 17500 "	"	= E's.

Their proportions are as the numbers 27, 36, 60, 39, and 175.

337 : 27 = $1000 : $80.12, A's; 337 : 36 = $1000 : $106.83, B's, &c.

(17.) ($500 × 12 = 6000) + ($250 × 9 = 2250) = 8250, A's product.

(650 × 12 = 7800) — (200 × 6 = 1200) = 6600, B's product.

(375 × 12 = 4500) + (400 × 5 = 2000) = 6500, C's product.

21350 : 8250 = $600 : $231.85, A's part of the gain, to which is to be added $275 for doing the business, making $506.85.

21350 : 6600 = $600 : $185.48, B's part.
21350 : 6500 = $600 . $182.67, C's part.

(18.) $1000 + $1600 + $1750 + $2250 = $6600. A is to receive $\frac{20}{132}$, B $\frac{32}{132}$, C $\frac{35}{132}$, and D $\frac{45}{132}$ of ($600 — $150.50.)

$\frac{449.50}{6600} = \frac{899}{13200} = .0681$, or $6\frac{81}{100}$ per cent.

136b. (1.) . . $4\frac{1}{7}$ to $3\frac{5}{8}$? Ans. 264 : 203. Of $13\frac{1}{4}$ to $16\frac{1}{8}$? Ans. 106 · 129.

(2.) . . 15.55 to 8.5? Ans. 311 : 170. Of 20.004 to 35.05? Ans. $\frac{1}{17}\frac{0}{5}\frac{0}{2}\frac{2}{5}$.

(3.) . . .0008 to .00001? Ans. 80 : 1. Of .007 to 7.0007? Ans. 70 : 70007.

(5.) . . $5\frac{1}{8}$: $3\frac{7}{16}$ and $6\frac{3}{8}$: $8\frac{3}{4}$. Ans. 357 : 305.

(6.) . . $5\frac{1}{7}$: $8\frac{3}{8}$ = $20\frac{5}{16}$: —? Ans. $30\frac{7}{16}\frac{1}{16}\frac{9}{16}$.

(7.) . . 3000 bricks . . 1 ft. broad, 40 ft. long, 5 ft. high, . . 18 in. broad, 140 ft. long and $12\frac{1}{2}$ ft. high?
Ans. 39,375 bricks.

(10.) . . $218\frac{3}{4}$ yds. long in 40 da. . 40 men; . . 30 days 175 yds. finished; how many men may he dismiss, and complete the work at the appointed time? Ans. 10 men.

(12.) 4 men . . A $\frac{3}{8}$, B $\frac{3}{10}$, C $\frac{3}{16}$, D $935 . . ?
Ans. A $2550; B $2040; C $1275.

(16.) Jan. 1st, A $2500 . June 1st, B . . $1500 . Aug. 1st, C $1000. Profits $1600. A's salary $400 . . int. at 6 per cent. . . . ?
Ans. A's $1191.21; B's $276.92; C's $131.87.

(17.) A at first $1800, 4 mo. after withdraws $250; B at first $1500, 6 mo. after $250 more; C at first $850, 5 mo. after $500 more. Gain $2450. How much of this gain must each receive, after allowing to each 6 per cent. for the use of his money, and to A a salary of $600?
Ans. A's $1286.74; B's $683.24; C's $480.02.

(18.) Three men . . A 1500, B $800, C 1000 . . rent $500 . . taxes, &c., $115 . . ?
Ans. A's $175; B's $93.33; C's $116.67.

137a. (2.) Oats $6.75 + rye $6 + barley $6 = $18.75; $18.75 ÷ 37 = $.50$\frac{3}{37}$.

(3.) 54 carats + 100 do. + 84 do. = 238; 238 ÷ 14 = 17 carats.

(4.) $101\frac{1}{4}$ yds. + 166 yds. + 126 yds. + $63\frac{3}{4}$ yds. = 457 yds.; 457 yds. ÷ 22 = $20\frac{17}{22}$ yds.

(5.) $11.88 + $15 + $12.48 = $39.36. 3 lbs. are worth $\frac{1}{18}$ as much as 54 lbs.; $39.36 ÷ 18 = 2.18\frac{8}{9}$.

137b. (2.) 25 bu. at $37\frac{1}{2}$ cents, 18 bu. at 65 cents, 15 bu. at 48 cents, . . 5 bu.? Ans. 1 bu. $.48$\frac{3}{4}$; 5 bu. 2.43\frac{3}{4}$.

(3.) . . $4\frac{1}{2}$ oz. 18 carats fine, 3 oz. at 21 carats, 5 oz. at $17\frac{1}{2}$ carats, 4 oz. alloy, . . ? Ans. $14\frac{1}{3}\frac{1}{3}$ carats fine.

(4.) . . 37 pieces; 8 pieces, $22\frac{1}{4}$ yds. each, 7 pieces at $24\frac{1}{2}$ yds., 2 pieces at 25 yds., 12 pieces at $19\frac{3}{4}$ yds., and 8 pieces at 20 yds. each? Ans. $21\frac{3}{7}\frac{9}{2}$ yds.

(5.) . . $15\frac{1}{2}$ lbs. at \$.375, $23\frac{1}{4}$ lbs. at \$.50, and $10\frac{3}{4}$ lbs. at $56\frac{1}{4}$ cents . . 1 lb.? 4 lbs.?

Ans. $\$23.48\frac{7}{1\,6} \div 49\frac{1}{2} = \$.47\frac{3}{8}\frac{9}{8}$, price of 1 lb.; $\$1.89\frac{1}{2}\frac{7}{2}$ price of 4 lbs.

138a. (3.) If the mixture is to be valued at 75 cents, he will gain 75 cents on every gallon of water, and lose 5 cents on every gallon of wine it contains. He must, therefore, use 15 gallons of wine to 1 of water. At 70 cents, 7 to 1; at 50 cents, 2 of wine to 1 of water; at 60 cents, 4 to 1; at 85 — such a mixture cannot be made.

(5.) On the 8 gals. at 50 cents, he will lose 40 cents; on the 3 gals. at 60 cents, he will lose 45 cents; and on each gal. of water he will gain 45 cents.

Ans. $85 \div 45 = 1\frac{8}{9}$ gal. of water.

On 5 gals. at 50 cents he will lose 25 cents, and on 6 gals. at 60 cents he will lose 90 cents. He must use as many gals. of water as there are times 45 cents in \$1.15.

Ans. $2\frac{5}{9}$ gals. of water.

(6.) If he takes 1 at 30, 1 at 36, and 1 at 40, there will be a loss of 20 cents, the value of the mixture being 42 cents; to gain this 20 cents, he must use $2\frac{1}{2}$ lbs. at 50 cents. If he takes 2 at 30, 1 at 36, and 1 at 40, there will be a loss of 32 cents; to *gain* 32 cents he must use 4 lbs. at 50 cents, &c., &c.

(7.) In using 1 gal. at \$1.75 and 1 at \$1.25, there will be a loss of \$1. Using 1 gal. of water will just balance this loss. He may, therefore, use equal quantities, or $266\frac{2}{3}$ gals. of each.

Again, if he use 2 at \$1.75 to 1 at \$1.25, there will be a loss on the 3 gals. of \$1.75. To balance this loss he must use $1\frac{3}{4}$ gals. of water. The proportions will then be 2 at \$1.75, 1 at \$1.25, and $1\frac{3}{4}$ of water, or as the numbers 8, 4, and 7.

Ans. $210\frac{1}{1}\frac{6}{9}$ gallons at \$1.75, $105\frac{5}{1}\frac{5}{9}$ at \$1.25, and $184\frac{4}{1}\frac{5}{9}$ of water.

(8.) On 1 lb. at 8 cents he will gain 1 cent, and on 1 lb. at 11 cents he will lose 2 cents. The proportions will be 1 at 8 and $\frac{1}{2}$ at 11 cents, or 2 at 8 to 1 at 11 cents, or $\frac{2}{3}$ of the whole at 8 cents, and $\frac{1}{3}$ at 11 cents.

(9.) 120 per cent. of 15 cents is 18 cents; 120 per cent. of 20 cents is 24 cents. He wishes to realize 18 cents per lb. for the first kind, and 24 cents for the other. On 1 lb. at 18 cents he will gain 2 cents; this will be balanced by using $\frac{1}{2}$ lb. at 24 cents. Ans. 2 lb. at 18 cents to 1 lb. at 24 cents.

(10.) On 12 bu. at 18d., there will be a gain of 288d.; to balance this, he may take 6 bu. at 4s., or 8 bu. at 3s., or 12 bu. at 2s., or varying quantities of each of these, as may suit convenience.

138b. No questions need be given here to exercise the learner; the teacher can supply them ad libitum.

139a. (1—4.) For answers, see Key.

(5.) One door 23 ft. 7′ 8″, 3 doors 70 ft. 11′.

(6.) Ceiling 15 ft. 6′ × 14 ft. 5′ = 223 ft. 5′ 6″; floor the same; the whole circuit of the room is 59 ft. 10 in. . . 59 ft. 10′ × 9 ft. 4′ = 558 ft. 5′ 4″.

Ans. (223 5′ 6″ × 2) + 558 5′ 4″ = 1005 4′ 4″.

(7.) The distance round the chest 23 ft. 4 in., multiplied by its depth, 3 ft. 7 = 83 ft. 7′ 4″, the surface of the four sides. 8 ft. 3′ × 3 ft. 5′ = 28 ft. 2′ 3″ = the top, and also the bottom. Ans. 83 7′ 4″ + 56 4′ 6″ = 139 11′ 10″.

(8.) The inside dimensions are 8 ft. 1 in., 3 ft. 3 in., and 3 ft. 5 in.

8 1′ × 3 3′ × 3 5′ = 89 ft. 9′ 1″ 3‴ = 155103 cu. in.; or 97 × 39 × 41 = 155103 cubic inches; 155103 ÷ 2150.4 = $72\frac{447}{3584}$ bu. = 72 bu. $4\frac{9}{11}$ qts.

(9.) 25 3′ × 21 4′ = 538 8′; and 538 8′ ÷ 9 = $538\frac{8}{9}$ ÷ 9 = $59\frac{23}{27}$ sq. yds.

(10.) 12 4′ × 10 3′ × 3 10′ = 484 7′ 2″ = $484\frac{1}{2}$ = 30 C. ft. $4\frac{1}{2}$ cu. ft. = 3 C. 6 C. ft. $4\frac{1}{2}$ cu. ft.

139b. (1.) 5 7′ × 8 3′ 4″ = 46 2′ 7″ 4‴. 13 0′ 8″ × 1′ 5″ = 1 6′ 5″ 11‴ 4⁗.

(2.) 3 8′ × 4 0′ 5″ × 3′ 4″ = 4 1′ 3″ 9‴ 1⁗ 4⁗′.

(3.) . . 10 ft. 4 in. long, 1 ft. 11 in. wide?

Ans. 19 ft. 9′ 8″.

(6.) . . 18 ft. 3 in. long, 15 ft. 10 in. wide, and 10 ft. 7 in high?

Ans. 1299 ft. 4′ 2″.

(7.) . . 3 ft. 8 in. long, 2 ft. 3 in. deep, 2 ft. 1 in. wide?
Ans. 41 ft. 1′ 10″ = $41\frac{11}{12}$ sq. ft.

(8.) . . Ans. 24150 cu. in. = $11\frac{582}{1728}$ bu.

(9.) . . 17 ft. 3 in. long, 15 ft. 9 in. wide?
Ans. 271 ft. 8′ 3″ = $30\frac{3}{16}$ sq. yd.

(10.) . . 15 ft. long, 6 ft. 7 in. high, and 4 ft. 2 in. wide?
Ans. 411 ft. 5′ 6″ = 3 C. 1 C. ft. $11\frac{11}{24}$ cu. ft.

143a. *Any complete divisor may, by doubling its unit figure, be taken for the next trial divisor.* This is frequently easier than to double all the figures of the root, as the rule directs.

In the solutions of the square and cube roots, the several *complete* divisors only are given; this part of the process being all that the teacher needs to enable him easily to detect any error in the work of the pupil.

(2.) Divisors, 65 . . 89 . . 167.

(3.) 22; 245 . . 142; 1,449 . . 20; 202; 2,044.

(4.) 85; 901; 9,029 . . 120; 1204; 12,084 . . 165; 1702; 17,048.

(5.) 65 . . 89 . . 167. (6.) 142 . . 1449 . . 22; 245 . . 202; 2044.

(7.) 85; 901; 9,029 . . 24; 282; 2849.

(10.) 27; 345; 3,501; 35,022 . . 100; 1000; 10,003; 100,065.

89; 982; 9,849; 98,586 . . 41; 422; 4,245; 42,502; 425,040; 4,250,401.

(11.) 105; 1101; 11,025; 110,301; 1,103,023; 11,030,-264.

27; 349; 3,581; 35,821; 358,228; 3,582,362.

42; 444; 4,485; 44,909; 449,184; 4,491,868; 44,918,-967.

(12.) 402; 4,046; 40,525; 405,302; 4,053,045; 40,530,-508.

48; 565; 5,707; 57,143 . . $\sqrt{.001,044,932}$. . 62; 643; 6462; 64,645.

(13.) $\sqrt{.00189445}$. . 83; 865; 8,702; 87,045.

$\sqrt{.\dot{6}}$. . 161; 1,626; 16,324; 163,289.

$\sqrt{8.000022944989}$. . 48; 562; 5,648; 56,564; 565,683; 5,656,861.

(14.) $\sqrt{5.625}$. . 43; 467; 4,741; 47,427; 4,743,408.

(15.) $\sqrt{7.265625}$. . 46; 529; 5,385; 53,904; 539,088; 5,390,962.

$\sqrt{4.721,296,296}$. . 41; 427; 4,342; 43,448; 434,565; 4,345,704.

143b. (3—6.) $\sqrt{2,125,764} = 1458$; $\sqrt{4,194,304} = 2048$; $\sqrt{8,168.5444} = 90.38$; $\sqrt{14,611.9744} = 120.88$.

(9.) $\sqrt{57\frac{19}{25}} = 7\frac{3}{5}$. (10.) $\sqrt{100\frac{1}{8}\frac{3}{6}} = 10.007+$; $\sqrt{28\frac{7}{8}} = 5.364492$.

(15.) $\sqrt{4\frac{3}{7} + \frac{5}{8} + 6\frac{7}{8}} = 3.4397—$; $\sqrt{4\frac{3}{7} \div 5\frac{1}{8}} = .92958—$.

145a. NOTE. The *trial* divisors after the first may be found *by adding to the last complete divisor the same product, and twice the square which were used in completing that divisor, and multiplying the sum by* 100. Thus, the first complete divisor in example 1 is 5169, adding to this $360 + 18$ makes 5547, which multiplied by 100 gives the second trial divisor.

This is much easier than to square the ascertained root.

(2.) Complete divisors. 5,169 . . 7,651 . . 21,441.

(3.) 31,216 . . 275,436 . . 3,076; 348,844.

(4.) 490,881 . . 16,444; 1,832,229 . . 1,939,264.

(5.) 25,119; 2,597,491; 260,223,859; 26,044,182,844.

11,916; 1,324,701; 134,348,596; 13,443,493,269.

516; 7,684,801; 769,248,516.

(6.) 12,501; 1,444,924; 146,286,876; 14,641,887,549; 1,464,253,726,626.

3,379; 418,519; 42,740,571; 4,285,272,711.

(9.) 15,124; 1,557,361; 155,973,931; 15,599,988,964; 1,560,050,816,656.

3,484; 434,341; 43,616,916 . . 25,396; 2,653,621.

(10.) 1,456; 177,889; 18,354,619; 1,841,327,571.

1,596; 205,149; 20,766,484; 2,078,543,056.

145b. (3.) $\sqrt[3]{8,998,912} = 208$; $\sqrt[3]{229,220,928} = 612$; $\sqrt[3]{320,013,504} = 684$.

(5.) $\sqrt[3]{548} = 8.183269$; $\sqrt[3]{.947} = .9820117$; $\sqrt[3]{\frac{54872}{216000}} = \frac{38}{60} = \frac{19}{30}$.

146a. (2.) $25 + 13 - 8 = 30$. (3.) $90 - 12 = 78$. (4.) $18 \times 2 \times 4 = 144$. (5.) $5 - 4 + 24 = 25$.

(6.) $9 + 24 = 33$. (7.) $45 \div 29 = 1\frac{16}{29}$. (8.) $560 + 2 + 45 = 607$. (9.) $75 - 22 + 45 = 98$.

(10.) $70 \times 6 + 30 = 450$. (11.) $15 + 32 - 7 = 40$. (12.) $15 + 32 - 3 = 44$.

(13.) $\frac{9}{24} + \frac{10}{24} - \frac{13}{24} = \frac{6}{24} = \frac{1}{4}$.

(14.) $\frac{15}{36} + \frac{8}{8} = \frac{23}{24}$; $\frac{5}{6} - \frac{3}{8} = \frac{11}{24}$; $\frac{23}{24} \times \frac{11}{24} = \frac{275}{576}$.

(15.) $\frac{3}{4} \times \frac{35}{72} \times \frac{5}{6} = \frac{525}{576}$; $\frac{525}{576} - \frac{3}{8} = \frac{273}{576}$.

(16.) $2\frac{1}{2} \div \frac{59}{442} = 18\frac{13}{59}$.

(17.) $42 \div 2.5 = 16.8$.

(18.) $11\frac{23}{24} \div \frac{3}{34} = \frac{287}{24} \div \frac{3}{34} = 135\frac{19}{36}$.

(19.) $16\frac{3}{8} \div \frac{4}{5} = 20\frac{15}{32}$; $\frac{4}{9} \times 8\frac{2}{3} - 2\frac{1}{6} = 3\frac{23}{27} - 2\frac{1}{6} = \frac{211}{216}$; and $20\frac{15}{32} - \frac{211}{216} = 20\frac{405}{864} - \frac{844}{864} = 19\frac{429}{864}$.

(20.) $5 + 24 - (4 + 5) = 20$. (21.) See Key. (22.) $1 - \frac{5}{14} = \frac{9}{14}$. (23.) $\sqrt{20\frac{1}{4}} = \sqrt{\frac{81}{4}} = \frac{9}{2} = 4\frac{1}{2}$.

147a. (2.) $3 \times 5 + 3 = 18$; $7 \times 5 + 3 = 38$; $14 \times 5 + 3 = 73$; $19 \times 5 + 3 = 98$.

(3.) $32.2 \times 7 + 16.1 = 241.5$. (4.) See Key. (6.) $(18 - 6) \div 4 = 3$ years.

(9.) $(1 + 24) \times 12 = 300$ times.

(10.) $(80.5 + 16.1) \times 1\frac{1}{2} = 144.9$ ft.; $32.2 \times 5 + 16.1 = 177.1$, the dist. it would fall the 6th second; then $(177.1 + 16.1) \times 3 = 579.6$ feet in 6 seconds. $32.2 \times 7 + 16.1 = 241.5$ ft. the dist. it would fall the 8th sec.; then $(241.5 + 16.1) \times 4 = 1030.4$ ft.

(11.) $\$.05 \times 300 = \$15.00$. (12.) $(69 + 15) \times 9\frac{1}{2} = 798$.

(13.) $\frac{5 \cdot 1 - 2}{1 \cdot 2} = 4$; $\frac{5 \cdot 1 + 2}{2} \times 13 = 351$.

(14.) $(33 + 3) \times 5\frac{1}{2} = \frac{3 \cdot 3 + 2}{2} + 11 = 198$.

147b. (2.) 1st term 5, com. dif. 3, . . . 8th term? Ans. 26.
(3.) . . 15th second? Ans. 466.9.
(4.) . . 5 per ct. . . 12 years? Ans. 160.
(6.) . . 8 sons, . . youngest 2, eldest 19½? Ans. 2½ com. dif.
(10.) . . 7 seconds? Ans. 788.9 feet.
(11.) . . at the age of 25 . . 8 cts. per day? Ans. $24; . $5 more per year, . . at the age of 45? Ans. $1430.00.
(14.) . . 7 wheels . . 1st 4 rev., last 35 rev., per second. Ans. 136½.

148a. (3.) The payment last due is $150 without interest; that due 1 year ago is $150 and 1 year's interest; that due 2 years ago, $150 and 2 years' interest, &c. The first term of the series is, therefore, $150, the com. dif. $9, or the int. of $150 for 1 year; the last term $150 + $9 × 9 = $231; the amount of all the terms ($231 + $150) × 5 = $1905.

(4.) The first term is $375; the common difference, $375 × .08 = $30; the last term, $30 × 4 + $375 = $495; the sum of all the terms, ($495 + $375) × 2½ = $2175.

(5.) The first term is $25, the common difference $.31¼, number of terms 12, last term $.31¼ × 11 + $25 = $28.43¾, sum of the terms ($25 + $28.43¾) × 6 = $320.62½.

148b. (3.) . . $275 . . 15 years . . 5 per cent. Ans. $5568.75.
(4.) . . $650 per annum, payable semi-annually 10 years, at 5 per cent? Ans. $8043.75.
(5.) . . semi-annually, $150 per annum, 8 years, . . 6 per cent.? Ans. $1470.00.

149a. (2.) $3^9 \times 1 = 19683$ cents. (3.) $(1.06)^8 \times 20 = \$31.87696$.
(4.) $(1.05)^{10} \times \$1050 = 1.628895 \times \$1050 = \$1710.3397$.
(5.) $3^7 \times 20 = 43{,}740$.
(7.) $4^9 \times 1 = 262{,}144$ the 10th term; and $[(262{,}144 \times 4) - 1] \div 3 = 349{,}525$; or $(4^{10} - 1) \div 3 = 349{,}525$.
(8.) The last payment was $3^{11} = 177{,}147$; $(3^{12} - 1) \div 2 = 265{,}720$.

149b. (4.) . . $550 . . 6 years, 5½ per cent.?
Ans. $758.3635.
(7.) . . 12 terms of the series 2, 4, 8, &c.? Ans. 8190.
(8.) . . $.50, $1.50, $4.50, &c.?
Ans. Last $88,573.50; Sum $132,860.

150a. (3.) There were 11 deposites.

Hence, $\frac{(1\times 1.06^{11})-1}{1.06-1}\times 10 = \frac{.898228}{.06}\times 10 = \$142.068$;

and $\frac{(1\times 1.05^{11})-1}{1.05-1} = \frac{.710339}{.05} = \$149.716.$

(4.) $\frac{(1.15)^{10}-1}{1.15-1}\times \$100 = \frac{3.04455}{.15}\times \$100 = \$2030.37.$

(5.) $\frac{(1.05)^{10}-1}{1.05-1}\times \$100 = \frac{.628894}{.05}\times \$100 = \$1257.79$;

$\frac{(1.025)^{20}-1}{1.025-1}\times \$50 = \frac{.638462}{.025}\times \$50 = \$1277.24$; $1277.24 − 1257.79 = $19.45.

(6.) $1500 × $(1.06)^{10} = 1500 \times 1.790848 = \$2686.272$ = the amount of $1500 for 10 years at compound interest.

$\frac{1.06^{10}-1}{1.06-1} = \$13.1808$ = the am'nt of an annual saving of $1 for 10 years; therefore, $\frac{\$2686.272}{\$13.1808} = \$203.802$, the annual saving to pay it in 10 years.

(7.) $1500 × $(1.06)^8 = 1500 \times 1.593848 = \$2390.772$, the amount of $1500 for 8 years at compound interest.

$\frac{(1.06)^8-1}{1.06-1} = \$9.8975$ = the amount of an annual saving of $1 for 8 years.

$\frac{\$2390.772}{\$9.8975} = \$241.555$, the annual saving to pay the debt in 8 years.

$1500 × $(1.06)^5 = 1500 \times 1.338226 = \$2007.339$, the amount of $1500 for 5 years, at compound interest.

$\frac{1.06^5-1}{1.06-1} = 5.6371$, the amount of an annual saving of $1 for 5 years.

$\frac{\$2007.332}{\$5.6371} = \$356.094$ = the annual saving to pay the debt in 5 years.

(8.) $\frac{(1.06)^{10}-1}{1.06-1} \times \$100 = \$1318.08 =$ the amount of an annuity of \$100 for 10 years.

$(1.06)^{10} = 1.790848 =$ the amount of \$1 for 10 years, at compound interest.

$\frac{\$1318.08}{\$1.79085} = \$736.009$ Ans.

(9.) $\frac{1.05^{20}-1}{1.05-1} \times \$200 = \$6613.19$; $(1.05)^{20} = \$2.653298$; and $\$66613.19 \div \$2.653298 = \$2492.439$, Ans.

(10.) $\frac{(1.06)^{10}-1}{1.06-1} \times \$150 = \$1977.12$; $(1.06)^{10} = 1.790848$; and $\$1977.12 \div 1.790848 = \$1104.01$.

(11.) $\frac{(1.05)^{25}-1}{1.05-1} \times \$400 = \$19,090.84 =$ the amount of the annuity for 25 years.

$(1.05)^{25} = \$3.386355$; $\$19,090.84 \div \$3.386,355 = \$5637.576$, the present worth of the annuity for 25 years, i. e., the present worth of both the annuities.

$\frac{(1.05)^{15}-1}{1.05-1} \times \$400 = \$8631.424$, the amount of the annuity for 15 years.

$(1.05)^{15} = \$2.078928$; $\$8,631.424 \div \$2.078928 = \$4151.864 =$ the present value of the widow's. $\$5637.576 - \$4151.864 = \$1485.71$, the present worth of the son's.

(12.) $(1.05)^{10} = 1.628895$; $\frac{(1.05)^{10}-1}{1.05-1} \times \$400 = \$5031.156$; and $\$5031.156 \div \$1.6289 = \$3088.69$, the widow's.

$(1.05)^{20} = \$2.653298$; $\frac{(1.05)^{20}-1}{1.05-1} \times \$400 = \$13,226.384$; $13,226.384 \div \$2.653298 = \$4984.884$; $\$4,984.884 - \$3,088.69 = \$1896.194$, the son's.

$(1.05)^{15} = 2.078928$; $\frac{1.05^{15}-1}{1.05-1} \times \$400 = \$8631.424$; $\$8631.424 \div 2.078928 = \$4151.864$, the present worth of both annuities.

$1.05^5 = 1.276282$; $\frac{1.05^5-1}{1.05-1} \times \$400 = \$2210.256$;

$2210.256 ÷ 1.276282 = $1731.79, the present worth of the widow's portion, if she lived 5 years.

$4151.864 — $1731.79 = $2420.07, the son's.

150b. A few examples, in some respects different from those in the book, are added here.

1. What sum will yield a perpetual annual payment of $150, interest at 6 per cent.? Ans. $150 ÷ .06 = $2500.

2. A new bridge is to be built over the river in the town of D. The expense of building it will be $5000; and it is estimated that an outlay of $1000 once in twenty years, in addition to an annual expense of $50, will be required to keep it in good repair. What sum of money, yielding an annual income of 5 per cent., will be sufficient to build the bridge and keep it in repair?

To build the bridge $5000 are required. To pay the annual expenses, such a sum is required as will yield $50 per annum, at 5 per cent., or $1000. For the outlay of $1000, such a sum must be invested as will yield $1000 in 20 years at 5 per cent., compound interest, or $1000 ÷ 1.653298 = $376.89.

Ans. $5000 + $1000 + $604.85. = $6604.85.

3. A person has a lease of a lot of land for 15 years, on which he wishes to erect buildings at an expense of $10,000. What net annual income will pay for them, and yield him 6 per cent., compound interest, for the use of the money expended in their erection?

See ex. 6, Art. 150. The amount of all the annual rents, at compound interest, must equal the amount of $10,000 for 15 years, at compound interest. $23,965.58 ÷ $23.275971 = $1029.63.

153a. (1.) $(20\frac{1}{2})^2 \div 160 = (\frac{41}{2})^2 \times \frac{1}{160} = \frac{1681}{640}$ A. = 2 A. 2 R. $20\frac{1}{4}$ sq. rd.

18 rd. $3\frac{1}{2}$ yd. = $102\frac{1}{2}$ yd.; $\frac{205}{2} \times \frac{205}{2} \times \frac{4}{121} = \frac{42025}{121}$ sq. rd. = 347 sq. rd. $9\frac{1}{2}$ sq. yd.

5 rd. 3 yd. 2 ft. = $93\frac{1}{2}$ ft.; $(\frac{187}{2})^2 = \frac{34969}{4} = 8742\frac{1}{4}$ sq. feet.

(4.) 15 ft. 8 in. = $15\frac{2}{3}$ ft.; $(\frac{47}{3})^2 = \frac{2209}{9} = 245\frac{4}{9}$ square feet.

154a. (7.) $(57 + 38) \times 2 \times 18 = 3420$ square feet.

158a. (11.) $\frac{20+30+40}{2} = 45$; $\sqrt{45 \times 25 \times 15 \times 5} = \sqrt{84375} = 290.4737$ = area of triangle ABC.

$\frac{25+30+40}{2} = 47\frac{1}{2}$; $\sqrt{47\frac{1}{2} \times 22\frac{1}{2} \times 17\frac{1}{2} \times 7\frac{1}{2}} = \sqrt{140{,}273\frac{7}{16}} = 374.53$ = area of triangle ACD.

$\frac{15+25+30}{2} = 35$; $\sqrt{35 \times 20 \times 10 \times 5} = \sqrt{35000} = 187.0829$ = area of triangle ADE.

(12.) $\frac{133 \times (37+44)}{2} = 5386\frac{1}{2}$ sq. yd. = the answer.

(13.) $\frac{72+80+133}{2} = 142\frac{1}{2}$; $\sqrt{142\frac{1}{2} \times 70\frac{1}{2} \times 62\frac{1}{2} \times 9\frac{1}{2}} = \sqrt{5{,}964{,}960.9375} = 2442.33$ — = area of triangle BAD.

$\frac{48+125+133}{2} = 152$; $\sqrt{152 \times 106 \times 27 \times 19} = \sqrt{8{,}265{,}456} = 2874.97+$ = area of triangle BCD. 2442,33 + 2874.97 = 5,317,3 sq. ft.

161a. (21.) $\sqrt{160 \div .7854} = 14.273$— rod.

NOTE. — Since areas of circles are to each other as the *squares* of their diameters or similar dimensions, (Art. **164,**) the diameters, or similar dimensions of circles are to each other as the *square roots* of their areas. Consequently the diameter of a circle which contains ¼ of an acre must be ½ of the diameter of one that contains 1 acre; and the diameter of one which contains 4 acres, must be twice the diameter of one which contains 1 acre; because the square root of ¼ is ½; and the square root of 4 is 2. The *pupil* need not be told this till he learns it on the next page.

162a. (27.) $\sqrt{8^2 \times 2} =$ Ans.

(28.) Since the square of the diagonal must be equal to twice the square of one of the sides, $\sqrt{(54)^2 \div 2} =$ Ans.

153 — 163b. (1.) . . 10.25 rods? Ans. 2 R. 25.0625 sq. rd.; . . 11 rd., 1 yd., 2 ft., 6 in.?
Ans. 3 R. 8 sq. rd., 13 sq. yd., 4 sq. ft.

(2.) . . 30⅝ A.? Ans. 70 rods.
(3.) . . 1296 sq. rd. . . ? Ans. 36 rods.
(4.) . . 25 ft. 7 in.? Ans. $654\frac{73}{144}$ sq. ft.
(5.) . . 30 rd. by 20 rd. . . ? Ans. 3¾ A.; one side 24.4949— rods.

(7.) . . 75 ft. long, 40 ft. wide, 19 ft. high?
Ans. 4370 sq. ft.

(8.) . . length $18\frac{1}{2}$ ft., width 12 in. and $20\frac{1}{2}$ in.?
Ans. $25\frac{5}{36}$ sq. ft. = 25 sq. ft., $7\frac{1}{2}$ sq. in.

(9.) . . one side 29 rods, perpendicular 15 rods?
Ans. 1 A. $12\frac{1}{2}$ sq. rd.

(10.) . . 20, 30, and 40 rods . . ?
Ans. 1 A. 3 R. 10.4737 sq. rd.

(11.) . . AB 4, BC 6, CD 5, DE 9, EA 5, AC 8, AD 6?
Ans. 11.61895 + 14.9813 + 7.4833 = 34.08346.

(12.) . . BD 150, AF 40, and CE 48 feet?
Ans. 6600 sq. ft.

(15.) . . pentagon side 16 inches, perpendicular 11 in.?
Ans. 3 sq. ft., 8 sq. in.

(16.) . . diameter 17 yds.? Ans. Cir. 53.4072 yds.

(17.) . . cir. 15 inches? Ans. Diam. 4.7746 + in.

(18.) . . radius 20 rods? Ans. Circum. 125.664 rods.

(19.) . . diameter $12\frac{1}{2}$ ft.? Ans. Area 122.71875 sq. ft.

(20.) . . cir. 72.5 ft.? Ans. Area 418.279 sq. ft.

(21.) . . area 100 sq. ft.? Ans. Diam. 11.28 ft.

(22.) . . $8\frac{1}{4}$ ft. and $10\frac{1}{2}$ ft.? Ans. Area 68.085275 sq. ft.

(25.) . . 18 ft. by 16 ft.? Ans. 24.083 ft.

(26.) . . hyp. 100, base 75 . . ? Ans. Perp. 66.144 —

(27.) . . 15 ft? Ans. Diag. 21.2132 ft.

(28.) . . diag. 38 ft.? Ans. Side 26.87 ft.

164a. (9.) "Give a reason for the rule for finding the area of circles."

Ans. The area of a circle inscribed in a square is .7854 of the area of the square; and as the area of a square is equal to the square of one of its sides, the area of a circle inscribed in a square must be .7854 of the square of one of the sides of the square, or, which is the same thing, .7854 of the square of the diameter of the circle.

(11.) If the diameter of the tube is twice as great, its area or section will be 4 times as large; if $2\frac{1}{2}$ times as great, $6\frac{1}{4}$ times as large, &c., because $2^2 = 4$; $(2\frac{1}{2})^2 = 6\frac{1}{4}$, &c.

(12.) If the area or section of the tube is to be 4 times as large, its diameter must be 2 times as great; if the area is to

be 9, or 16 times as large, the diameter must be 3, or 4 times as great; because $\sqrt{4} = 2$; $\sqrt{9} = 3$, &c.

(13.) If the line is to cut off $\frac{5}{12}$ from the *top* of the triangle, then the area cut off being $\frac{5}{12}$ of the whole triangle, $\sqrt{\frac{5}{12}} \times 12$ will be the length of the side of the part cut off. Or, by proportion, the areas are to each other as 12 to 5; the similar sides will therefore be to each other as $\sqrt{12}$ to $\sqrt{5}$; that is, the *squares* of the similar sides will be as 12 to 5 . . $12 : 5 = (12)^2 : 60 =$ the square of the answer. $\sqrt{60} = 7.745,967$.

If the line is to cut $\frac{5}{12}$ from the *lower* part of the triangle, the area of the similar triangle cut off, will be $\frac{7}{12}$ of the whole triangle, and $\sqrt{\frac{7}{12}} \times 12$ will be the length of the side of the part cut off. $12 : 7 = (12)^2 : 84 =$ the square of the answer. $\sqrt{84} = 9.165,151$.

(14.) Here the similar sides are as 1 to 2; the areas are therefore as 1 to 4.

(15.) The number of threads will be in proportion to the area of the section of the rope; $6^2 : (14)^2$, or $3^2 : 7^2 = 450 :$ Ans.

(16.) $2^2 : 3^2 = 117 :$ Ans.; $\sqrt{4} \cdot \sqrt{1} = 10 :$ Ans.

(17.) $3^2 : 2^2 = 85 :$ Ans.

(18.) The pole and its shadow on level ground form the perpendicular and base of a right angled triangle; the steeple and *its* shadow the perpendicular and base of a similar triangle $7\frac{1}{2} : 10 = 140 :$ Ans.

(19.) The width of the base does not affect the result. $2 : 1 = (12)^2 : (\text{Ans.})^2$ $\sqrt{72} = 8.4853$—; $3 : 12 = (12)^2 : (\text{Ans.})^2$.

164b. (11.) . . $1\frac{1}{2}$ in. . . 3 gal. per min. . . $2\frac{1}{2}$ in.? Ans. $8\frac{1}{3}$ gal.

(12.) . . $1\frac{1}{4}$ in. . . 5 gal. per min. . . 20 gal. per min? Ans. $2\frac{1}{2}$ in.

(13.) . . $\frac{3}{4}$ of the whole? Ans. 1.608 ft., or 6 ft.

(14.) . . 3 ft. from base?

Ans. $\frac{9}{16}$ above, and $\frac{7}{16}$ below the line.

(15.) . . 8 in. . . 500 threads. . . 15 in ?
Ans. 1758 nearly.

(16. . . 12 in. . . 150 lb. . . 8 in. ? . . $\frac{1}{3}$?
Ans. $66\frac{2}{3}$ lb.; 6.9282 in.

(17.) . . area 75, . . one side 25, . . 15 ? Ans. 27.

(19.) 15 ft. long, . . . cut off $\frac{1}{5}$? $\frac{3}{8}$?
Ans. 6.7082; 9.1856.

165a. (2.) $\sqrt{(15)^2 \times 2} =$ Ans. (3.) $\sqrt{(20)^2 \div 2} =$ Ans.

(8.) $(18)^2 \times .7854 =$ Ans. The area of a circle whose diameter is 36 rods, is 4 times as much as of one whose diameter is 18 rods; if the diameter is 9 rods, $\frac{1}{4}$ as much; if 3 rods, $\frac{1}{36}$ as much.

(9.) $\sqrt{2560 \div .7854} =$ Ans. For 64 acres, twice as great; 4 acres, $\frac{1}{2}$ as great, &c.

(12.) The area of a section of the pipe must be twice as great; therefore multiply the given diameter by $\sqrt{2}$.

(14.) $7 \times \sqrt{10} =$ Ans. (17.) $\sqrt{1936} = 44$.

(19.) $\sqrt{(16)^2 + (9)^2} =$ Ans.

(20.) $\sqrt{(144)^2 - (72)^2} =$ Ans.

(21.) $(5\frac{1}{2} \times 3.1416) \div 6 =$ first Ans.

(22.) The lines AB and AC, in the diagram, are two equal sides of a right angled triangle, of which BC is the hypothenuse; therefore $(AB)^2 + (AC)^2 = (BC)^2$; or, since AB and AC are equal, $(AB)^2 = \frac{(BC)^2}{2}$, and $AB = \sqrt{\frac{(BC)^2}{2}} = \sqrt{.5} =$ Ans.

(23.) The radius is evidently one half the length of the diagonal of the square. See last example.

(24.) $\overline{(24)^2 \times .7854} - \frac{(24)^2}{2} =$ Ans.

(25.) $\overline{(24)^2 - (24)^2 \times .7854} =$ Ans.

165b. (2.) . . 10 ? Diag. 14.142.

(3.) . . 28 ? one side 19.799—.

(4.) . . 35 and 44 . . ? . . ? Area 1540; diag. 56.2228.

(5.) . . 40 E, 80 S. . . ? Ans. 89.4427.

(8.) . . 23 yds. ? Ans. 415.4766 sq. yd.

(9.) . . 2½ A.? Diam. 22.57 rd.
(10.) . . 60 long, 30 wide . . ? Ans. 22.91796.
(11.) . . 25 by 18 rods . . $100 per A.? . . $1.75 per rod?. . . centre? Ans. $281.25; $150.50; 15.40292 rods.
(12.) . . 1¾ in. . . 5 h. . . 2 h.? Ans. 2.767— in.
(13.) If 1 ft. . . 75 lb. . . 1½ in. . . 6 ft. . . 1½ in? Ans. 312½ lb.
(14.) . . 10½ in. . . 15 times as much? Ans. 40.6663 in.
(15.) . . 750 poles . . ⅓ as large. . . ? Ans. Side 15.81139— rods.
(16.) . . 150 by 80 . . ? Ans. 438.178.
(18.) . . base 175, hyp. 275? Ans. Perp. 212.132.
(19.) . . 28 ft. . . 8 ft. Ans. 16.1245 ft.
(20.) . . 15 ft.? Ans. 16.77 ft.
(21.) . . 4¾ ft. . . 6? . . 5? Ans. 14.9226 ft.; 2 ft. 5.845 in.; 2 ft. 11.81424.
(22.) . . diam. 40 in.? Ans. 28.28427.
(24.) . . diam. 14 . . ? Ans. 153.938 — 98 = 55.938.
(25.) . . side 30 . . ? Ans. 193.14.

167b. (2.) . . 3 ft. 7 in.? Ans. $77\frac{1}{4}$ sq. ft.
(3.) . . 3 ft. 7 in.? Ans. $46\frac{12}{144}$ cu. ft.

169a. (5.) The area of an equilateral triangle is equal to ¼ of the square of one of its sides, multiplied by the square root of 3. Hence, $4 \times \sqrt{3} = 6.928$ sq. ft., the area of one end, and $\overline{12 \times 12} + 2 \times 6.928 =$ the answer.

Or the area of the ends may be found by Art. **157**, Rule II.

If each of the equal sides is 5½ ft., it will be $(5\frac{1}{2})^2 \div 4 \times \sqrt{3} = 13.098$ sq. ft. for the area of one end; and $(13.098 \times 2) + (16\frac{1}{2} \times 12) =$ Ans.

(9.) The inside dimensions are 4 ft. 4 in., 2 ft. 4 in., and 2 ft. 10 in.

169b. (5.) . . length 13 feet, sides of base 23, 34, and 19 in. Ans. 82⅓ sq. ft. + (208.1345,719 ÷ 144) × 2 = 85.22222 sq. ft.

(8.) . . 12 ft. radius of base, 23 in.? Ans. 167.5956 sq. ft

(9.) . . outside, length 7 ft. 8 in., breadth 4 ft. 7 in., depth 2 ft. 9 in? Ans. $137\frac{7}{12}$ sq. ft.

170b. (14 and 15) . . rectangular cistern 3 ft. 2 in. long, 2 ft. 8 in. broad, and 2 ft. 6 in. deep?
Ans. $21\frac{1}{3}$ cu. ft.; $158\frac{1}{3}$ gal.

171a. (18.) $32 \div 3.1416 = 10.186$, the radius of the base, and $\sqrt{10.186^2 + 118^2} = \sqrt{103.7546 + 13{,}924} = 118.44$ ft., the slant height of the cone; whence $118.44 \times 32 \times 8\text{d.} \div 9 = 3368.96\text{d.} = £14\ 0\text{s.}\ 8.96\text{d.}$ the answer.

172a. (19.) $14^2 \times 4\frac{2}{3} = 14^3 = \text{Ans.}$; $(1\frac{1}{3})^3 \times 4\frac{1}{12} = \frac{16}{9} \times \frac{49}{12} = 7\frac{7}{27}$ cu. ft.

(20.) $[(2\frac{1}{2})^3 \times .7854] \times 5 = 21.3803$ cu. ft., Ans.

(21.) $(2\frac{1}{12})^3 \times 6\frac{2}{3} = \text{Ans.}$

173a. (22.) $\frac{(40+26)\times 4}{2\times 12} \times 10 = 11 \times 10 = 110$ sq. ft., the surface of the sides. $(\frac{10}{12})^2 + (\frac{26}{12})^2 = (\frac{10}{12})^2 + (\frac{13}{6})^2 = 15\frac{28}{36}$, the area of the two ends.

(23.) $.7854 \times 43^2 = 1452.2046$ sq. in. area of the greater base, and $.7854 \times 23^2 = 415.4766$, the area of the less base; also, $[(3.1416 \times 43) + (3.1416 \times 23)] \times 108 \div 2 = 11196.6408$ in curve surface.

(24.) $\frac{3\frac{1}{2}+2}{2} \times 4 \times 15 = 11 \times 15 = 165$ sq. ft., the area of the four sides; and $\frac{165}{8} = \$20.62\frac{1}{2}$, Ans.

(25.) $(63+38)^2 - (63\times 38) = 10{,}201 - 2394 = 7807$; and $7807 \div (4 \times 3.1416) = 621.26$; then $621.26 \times 19 \div 144 = 81.972$ cu. ft. the ans.

(26.) $\frac{\sqrt{18^2\times 13^2 + 18^2 + 13^2}}{144} \times \frac{25}{3} = \frac{234+324+169}{144} \times \frac{25}{3} = \frac{727}{144} \times \frac{25}{3} = 42.07$ cu. ft., Ans.

(27.) $(\sqrt{4^2\times 3^2 + 4^2 + 3^2}) \times \frac{12}{3} \times \frac{2000}{12\frac{1}{2}} = (12+16+9)\times 4 \times 160 = 23680$; or, $\sqrt{4^2\times 3^2 + 4^2 + 3^2} \times \frac{12}{3} = (4\times 3 + 16 + 9)\times 4 = 148$ cu. ft. content. and $148 \times \frac{2000}{12\frac{1}{2}} = 23680$ lb.

(29.) $(34 \times 2 + 28) \times 10 \times 25 \div 6 = 960 \times 25 \div 6 =$ 4000 cu. in. $= 2.31\dot{4}\dot{8}$.

176a. (30.) $3.1416 \times 15 \times 15 = 706.86$ sq. ft., the Answer.

(31.) $3.1416 \times 8000 \times 8000 =$ the Answer.

(32.) $3.141.592,653,589,793 \times 7912 = 24,856.281,075,202,442 =$ the earth's circumference.

24856.281, &c. $\times$ 327.19 = the surface of each frigid zone.
24856.281, &c. $\times$ 2053 467 = " " temperate zone.
24856,281, &c. $\times$ 3150.677 = " " the torrid zone.

177a. (33.) $16^3 \times .5236 =$ Ans.

178a. (35.) $\sqrt[3]{3^3 \times .5236} =$ Ans.

(36.) $\sqrt{55 \times 27 \times 21} = \sqrt{31185} = 31.474$ in. $=$ 2 ft. 7.474 in., Ans.

(37.) $\sqrt[3]{231 \times 5.00} =$ Ans.

(38.) $15^2 \times .7854 = 176.715$ sq. inches, area of base, and $\sqrt[3]{176.715 \times 18} = \sqrt[3]{3180.87} =$ Ans.

(39.) $\sqrt[3]{12^3 \times 3}$, or $\sqrt[3]{3} \times 12 =$ the Ans.

(40.) $\sqrt[3]{24^3 \times \frac{3}{4}}$ or $\sqrt[3]{\frac{3}{4}} \times 24 =$ the Ans.

(41.) $\sqrt[3]{2450.4 \times 1000} =$ the Ans.

179a. (42.) It may be demonstrated by geometry, that the solidity of a sphere is equal to $\frac{2}{3}$ of that of the circumscribing cylinder of the same height. And since the solidity of a cylinder, whose height and diameter are equal, is found by multiplying the *square* of the diameter by .7854, and that product by the height, or, the diameter and height being equal, by multiplying the *cube* of the diameter by .7854, the solidity of a sphere must be equal to the cube of the diameter multiplied by $\frac{2}{3}$ of .7854, which is .5236.

(47.) The solidity of a sphere inscribed in a cube is equal to .5236 of the solidity of the cube; and as the solidity of a cube is equal to the cube of one of its sides, the solidity of a sphere inscribed in a cube must be .5236 of the cube of one of the sides of the cube, or, which is the same thing, .5236 of the cube of the diameter of the sphere.

(48.) It may be demonstrated, that if four numbers form a proportion, then the squares, cubes, square roots, &c., cube roots, of those numbers, also form a proportion, thus:

If $4 : 9 = 16 : 36$, then $4^2 : 9^2 = 16^2 : 36^2$, and $4^3 : 9^3 = 16^3 : 36^3$; also $\sqrt{4} : \sqrt{9} = \sqrt{16} : \sqrt{36}$, &c.

Hence, from note 2, we have the following: As any dimension of one solid is to the like dimension of a similar solid, so is the cube root of the solidity of the former solid to the cube root of the solidity of the latter. The whole truth may be thus expressed. · *The contents of similar solids are to each other as the cubes of their like dimensions; and like dimensions of similar solids are to each other as the cube roots of their contents.* Hence,

(48.) $555\frac{5}{9} : 15 = 20^3 : (\text{Ans.})^3$. $\sqrt[3]{216} = 6$ in. Or $\sqrt[3]{555\frac{5}{9}} : \sqrt[3]{15} = 20 :$ req. diam., i. e., $\sqrt[3]{\frac{5\times 9}{1000}} \times 20 = \sqrt[3]{\frac{27}{1000}} \times 20 = \frac{3}{10} \times 20 = 6$, the same as before.

(49.) $37.63 \times (1\frac{1}{2})^3 = 37.63 \times 421.875 = 15875.15625$ gal., the Ans.

(50.) $(\frac{3}{2})^3 \times 3 = 10\frac{1}{8}$ C.

(51.) $(1\frac{3}{14})^3 \times 1000 = .800{,}656 \times 1000 =$ the ans.; or, $14 : 13 = \sqrt[3]{1000} : \sqrt[3]{\text{Ans.}}$, i. e., $14 : 13 = 10 : 9.2857$, the cube of which is 800.656, the Ans.

(52.) The form or dimensions of the base do not affect the result, if the cone or pyramid is regular; because the part cut off from the top must be similar to the whole. See 48, above. As the part toward the small end is to the whole as 1 to 2, the *length* of the two parts must be as $\sqrt[3]{1}$ to $\sqrt[3]{2}$. Hence, $\sqrt[3]{2} : \sqrt[3]{1} = 12 :$ dist. of the section from the apex. Or $2 : 1 = 12^3 : (\text{Ans.})^3$. $\sqrt[3]{864} = 9.5244$. $12 - 9.5244 = 2.4756$ ft. from the base.

(53.) $2 : 1 = 15^3 : (\text{Ans.})^3$, or $\sqrt[3]{2} : \sqrt[3]{1} = 15 : 11.9055$, the Ans.

$3 : 1 = 15^3 : (\text{Ans.})^3$, or $\sqrt[3]{3} : \sqrt[3]{1} = 15 : 10.4$ ft., the Ans.

$3 : 2 = 15^3 : (\text{Ans.})^3$, or $\sqrt[3]{3} : \sqrt[3]{2} = 15 : 13.1032$ ft., the Answer.

(54.) It will cut off $\frac{2}{3}$ of the height; the content of the part cut off is, therefore, $\frac{8}{27}$ of the whole, because $(\frac{2}{3})^3 = \frac{8}{27}$.

(55.) The larger stack is $1\frac{1}{2} = \frac{4}{4}$ of the height of the smaller one, it will therefore weigh $1\frac{2}{6}\frac{5}{4}$ of the smaller, because $(\frac{5}{4})^3 = 1\frac{2}{0}\frac{5}{4}$. $1\frac{2}{6}\frac{5}{4} \times 4 = 7\frac{3}{8}$ tons.

(56.) It will weigh $2\frac{7}{8}$ of 4 lbs., because $(1\frac{1}{2})^3 \times 4 = (\frac{3}{2})^3 \times 4 = 2\frac{7}{8} \times 4 = 13\frac{1}{2}$ lb., the Ans.

(57.) He will weigh $\frac{1}{17}\frac{9}{28}\frac{1}{8}$ of 200 lbs.; because. $(\frac{11}{12})^3 \times 200 - \frac{1}{17}\frac{9}{28}\frac{1}{8} \times 200 = 568\frac{13}{216}$ lbs.

(58.) A ball 2 in. in diam. contains $2^3 \times .5236 = 4.1888$ cubic inches; it will, therefore, weigh $\frac{4.1888}{17.28} \times 11,352$ oz. $\frac{8 \times 5236 \times 11352}{17280} = \frac{1 \times 5236 \times 4 \times 3}{3} = 27.5181$ oz. A ball 4 in. in diameter will weigh 8 times as much; a ball 6 in. in diam. 27 times, one 8 in. in diam. 64 times, and one 12 in. in diam. 216 times as much as a ball 2 in. in diam.

(59.) See book. $\frac{1}{16} = .0625$; $\sqrt[3]{.\frac{0}{5}\frac{6}{2}\frac{2}{3}\frac{5}{6}} = \sqrt[3]{.119366} = .49237+$ of a ft. $= 5.90814$ in.

179b. (48.) . . 10 in. . . 75 lb. . . 10 lb. ?
Ans. 5.108 in

(49.) . . 6 in. . . 1 gal. . . 21 in? Ans. $42\frac{7}{3}$ gal.

(50.) . . 3 ft. . . 10 cords . . $3\frac{3}{4}$ ft.? Ans. $19\frac{17}{32}$ C.

(53.) . . cone 25 in. long. . . ?
Ans. 19.8425 in.; 17.334 in.; 21.839 in. from the top.

(54.) . . cone 25 in. long. . . 10 in. from base?
Ans. $\frac{27}{125}$ of it.

(57.) . . $5\frac{1}{2}$ ft. . . 140 lbs. . . $7\frac{1}{2}$ ft.? Ans. 355 lbs.

180a. (1.) $(23 \times 17 \times 1) \div 12 = 28\frac{8}{96}$.

193a. (2.) $(8+5) \times 2 + (4 \times \frac{2}{3}) = 28\frac{2}{3}$ ft., length of the walls. $28\frac{2}{3} \times 7 \times \frac{2}{3} = \frac{1204}{9} = 133\frac{7}{9}$ cu. ft., the content of the walls. 9 ft. 4 in., and 6 ft. 4 in., the dimensions of the foundation. $9\frac{1}{3} \times 6\frac{1}{3} \times \frac{2}{3} = \frac{28}{3} \times \frac{19}{3} \times \frac{2}{3} = \frac{1064}{27} = 39\frac{11}{27}$ cu. ft. in the foundation. $\frac{1064}{27} + \frac{3612}{27} \times 27 = 1,064 + 3,612 = 4,676$, the number of bricks.

(3.) 5 ft. 10 in. the mean of the inside and outside diameters, $5\frac{5}{6} \times 3.1416 = 18.326$, the length of the wall. (*Note.* To multiply by $5\frac{5}{6}$, multiply by 5 and increase that product by $\frac{1}{6}$ of itself.) $18.326 \times 8 \times \frac{5}{6} = 122.1733$ cu. ft. in the walls. The foundation is 6 ft. 8 in. in diameter. $(\frac{20}{3})^2 \times .7854 = \frac{400}{9} \times .7854 = \frac{314}{9}\frac{16}{00} = 34.9067$ the area of the base; and $34.906\dot{} \times \frac{2}{3} = 23.27\dot{1}$ cu. ft. in the foundation. $23.271 + 122.17\dot{3} = 145.\dot{4}$ cu. ft., the Ans.

This question may be solved by calling the circumference $3\frac{1}{7}$ times the diameter, and multiplying $\frac{1}{2}$ the diameter by $\frac{1}{2}$

the circumference, to get the area of the base; the result will be nearly the same. Thus, $\frac{25}{8} \times \frac{22}{7} \times 8 \times \frac{1}{8} = 122\frac{3}{8}$ cu. ft. in the walls; $\frac{20}{3} \times \frac{22}{7} \times \frac{20}{3} \times \frac{1}{4} \times \frac{2}{3} = 23\frac{53}{189}$, the cu. ft. in the foundation; because $\frac{20}{3} \times \frac{22}{7} =$ the circumference, and $\frac{1}{4}$ of the circum. $\times$ the diam. $= \frac{1}{2}$ circum. $\times \frac{1}{2}$ diam.

$122\frac{3}{8} + 23\frac{53}{189} = 145\frac{95}{189}$ cu. ft., nearly the same as by the other method.

(4.) $(38 + 23)\ 2 + 5 = 127$ ft., length of walls, and $127 \times 5 \times 1\frac{1}{4} = 793\frac{3}{4}$ cu. ft., the Ans.

(5.) The capacity of a cistern, whose diameter is 2 ft. and depth 3 ft., is $= 2^2 \times .7854 \times 3 \times 7\frac{1}{2} = 70.686$ gallons. $20{,}000 \div 70.686 = 283$ nearly. The capacity of the required cistern must therefore be 283 times that of a cistern whose diameter is 2 ft. and depth 3 ft. $\sqrt[3]{283} = 6.565414$. $6.565 \times 2 = 13.13$ feet, the diameter, and $6.565 \times 3 = 19.7$ feet nearly, the height.

$13.13 + .\dot{6} = 13.8$ nearly, mean of the inside and outside diameters. $13.8 \times 3.1416 \times 19.7 \times .\dot{6} = 569.384$ cu. ft. in wall. $13.13 + 1.3 = 14.46$, outside diam.

$(14.46)^2 \times .7854 \times .\dot{6} = 209.0916 \times .5236 = 109.48036+$ cu. ft. in the foundation; $(14.46)^2 \times .7854 \times .5 = 209.0916 \times .3927 = 82.17027+$ cu. ft. in top; $569.384 + 109.48 + 82.17 = 761.03$ cu. ft. $761 \times 27 = 20547$ bricks, the Ans.

Let the pupil do it also by calling the circumference $3\frac{1}{7}$ times the diameter, which is sufficiently exact for common use, and get the area by the 1st rule, Art. **160.** Thus, the capacity of a cistern whose diameter is 2, and depth 3 ft., is $\frac{2 \times 3\frac{1}{7}}{2} \times \frac{2}{7} \times 3 \times 7\frac{1}{2} = \frac{22}{7} \times 3 \times \frac{15}{2} = \frac{990}{14} = 70\frac{5}{7}$ gals. $20000 \div 70\frac{5}{7} = 283$ nearly. Then, having found the dimensions as above, $13.8 \times 3\frac{1}{7} \times 19.7 \times \frac{7}{8} = 13.8 \times \frac{22}{7} \times 19.7 \times \frac{7}{8} = 569.61$ cu. ft. in the wall. $\frac{14.46 \times 3\frac{1}{7}}{2} \times \frac{14.46}{2} \times \frac{2}{3} = 7.23 \times \frac{22}{7} \times 7.23 \times \frac{2}{3} = 109.5242$ cu. ft. in the foundation, and $7.23 \times \frac{22}{7} \times 7.23 \times \frac{1}{2} = 82.1288$ in the top. $569.61 + 109.524 + 82.13 = 761.364$ cu. ft. in the whole; $761.364 \times 27 = 20557$ bricks, the Answer.

(6.) The capacity of a bin, whose dimensions are 4, 3, and 2 ft., is $4 \times 3 \times 2 \times \frac{45}{56} = \frac{135}{7} = 19.3$ bushels. $1000 \div 19.3$

$= 51.8$. $\sqrt[3]{51.8} = 3.728$ nearly. $3.728 \times 4 = 14.912$ ft. the length, 11.184 ft. the width, and 7.456 ft. the height.

(7.) $(14.91 + 11.18) \times 2 + (\frac{1}{2} \times 4) = 52.7$, and $52.7 \times 7.456 \times 1\frac{1}{2} = 589.4$ sq. ft., and $.5894 \times 18 = \$10.6092$.

192b. (1.) . . $12\frac{1}{2}$ A. . . 5 times . . ?
Ans. 20 and 100 rods.

(1.) . . $7\frac{7}{20}$ A. . . $\frac{3}{5}$ as long as wide?
Ans. 21 and 56 rods.

193b. (1.) . . 40 ft. by 25 . . 30 ft. high, no gable ends, walls 16 in. thick? Ans. 134,640 bricks.

(2.) . . *inside* . . 6 long, 4 wide, 8 deep, walls, &c., 6 in. thick, top covered 4 in. thick? Ans. $3163\frac{1}{2}$ bricks.

(3.) . . diam. 8 ft. . . depth 10 ft., walls and foundation 8 in., top uncovered? Ans. (The circum. being $3\frac{1}{7}$ times the diam.) $181\frac{37}{63} + 45\frac{11}{168} = 227\frac{41}{168}$.

(4.) . . 32 long, 18 wide, 6 high, walls 1 ft. thick?
Ans. 624 cu. ft.

(5.) . . 10,000 gal., diam. $\frac{3}{5}$ of the depth, walls and foundation 6 in., top 4 in. thick?

$\sqrt[3]{10000 \div 264\frac{3}{8}} = 3.3568$. Diam. 10.07 ft.; depth 16.784 ft.; walls 279 cu. ft.; bottom 48+; top 32+ cu. ft.
Ans. 9,693 bricks.

(6.) . . 500 bush. . . the bottom square, and the height $1\frac{3}{5}$ of the length of one side? $\sqrt[3]{500 \div 160.714} = 1.46$ nearly.
Ans. Bottom 7.3 ft., height 11.68 ft.

195a. (3.) $\frac{2000 \times 1\frac{1}{4}}{13\frac{3}{4}} =$ the Ans., because $2000 \times 1\frac{1}{4}$ being the product of the weight multiplied by its distance from the fulcrum, must also be the product of the power multiplied by its distance from the fulcrum. Dividing this product, therefore, by the length of the longer arm, will give the power required. $\frac{2000 \times 1\frac{1}{4}}{13\frac{3}{4}} = \frac{2000 \times 5}{55} = 181\frac{9}{11}$, the Answer.

Again, $\frac{325 \times 13\frac{3}{4}}{1\frac{1}{4}} =$ the other answer. $325 \times 13\frac{3}{4}$ being the product of the power multiplied by the longer arm, is also the product of the weight multiplied by the shorter arm;

therefore, dividing this product by the shorter arm will give the weight $\frac{325 \times 13\frac{3}{4}}{1\frac{1}{4}} = \frac{325 \times \frac{11}{55}}{5} = 3575$ lbs.

(4.) See note 2d.

(5.) The whole lever is to sustain a weight of $33\frac{1}{4}$ lb. $\frac{3\frac{1}{4}}{33\frac{1}{4}} \times 3\frac{1}{2}$ ft. will be the length of the shorter arm, and $\frac{30}{33\frac{1}{4}} \times 3\frac{1}{2}$ ft. the length of the longer arm; $\frac{3\frac{1}{4}}{33\frac{1}{4}} \times 3\frac{1}{2} = \frac{13}{133} \times \frac{7}{2} = \frac{91}{266}$ of a foot $= 4$ in., the length of the shorter arm, and $\frac{30}{33\frac{1}{4}} \times 3\frac{1}{2} = \frac{\overset{60}{120}}{\underset{19}{\overset{}{33}}} \times \frac{7}{2} = 3\frac{3}{19}$ ft. $= 3$ ft. 2 in. nearly, the longer arm.

(6.) The man who lifts at the end of the stick is $7\frac{1}{2}$ ft. from the centre of gravity; the other must be only half as far, viz., $3\frac{3}{4}$ ft. from it.

(7.) $\frac{500 \times 2}{10} = 100$ lb.; $\frac{500 \times 8}{10} = 400$ lb.; $\frac{500 \times 5}{10} = 250$ lb.; $\frac{500 \times 3\frac{1}{2}}{10} = 175$ lbs.

(8.) $\frac{5 \times 18}{1\frac{1}{2}} = 60$ lb., $\frac{5 \times 18}{100} = .9$ ft. from the fulcrum.

(9.) $\frac{100 \times 10}{5} = 200$ lb.; $\frac{100 \times 10}{300} = 3\frac{1}{3}$ feet from fulcrum.

195b. (2.) . . 175 lb. . . 10 ft. long . . 9 in. . . ?
Ans. $2{,}158\frac{1}{3}$ lb.

(3.) . . 12 ft. long . . 10 in. . . 1500 lbs.?
Ans. $111\frac{2}{17}$ lbs.

(4.) . . wt. 1500 lb., power 160 lb. . . 12 ft. long?
$1\frac{1}{2}\frac{3}{3}$ from wt.

(6.) . . 18 ft. long . . ? Ans. $4\frac{1}{2}$ ft. from one end.

(8.) . . 10 ft. long . . 6 in. . . power 20 lb.?
Ans. wt. 400 lb.

(9.) . . wt. 500 lb., 12 ft. from fulcrum, power 2 ft.?
Ans. 3000 lb.

196a. (1.) $\frac{180 \times \frac{1}{2}}{4\frac{1}{2}} = 20$ lb.

(2.) $\frac{145 \times 6 \times 12}{5\frac{1}{2}} = \frac{145 \times 6 \times 12 \times 2}{11} = 1898\frac{2}{11}$ lb.

(3.) $\frac{2\frac{1}{2} \times 14}{7} = 3\frac{3}{5}$ in., Ans. (4.) $\frac{3 \times 50}{15} = 10$ lb., Ans.

196b. (2.) . . radius 5 ft. . . axle 3 in. . . 180 lb. . . ?
Ans. 3600 lb.
(3.) . . radius 5 ft. . . power 120 lb. . . wt. 1000 lb ?
Ans. $7\frac{1}{5}$ in.
(4.) . . arm 1 ft. . . axle 5 in. diam. . . 75 lb. ?
Ans. $15\frac{5}{6}$ lb.

197a. (1.) $2^4 : 1 = 640 : 40$ lb., Ans.
(2.) $1 : 3 \times 2 = 15 : 90$ lb.; $3 \times 2 : 1 = 1500 : 250$ lb.

197b. (1.) . . 140 lb. 3 mov. pulleys as No. 3, . . ?
Ans. 1120 lb.
(2.) . . power 25 lb. . . 4 pulleys as No. 4 ?
Ans. 200 lb.
What power to balance 1000 lb. ? Ans. 125 lb.

198a. (1.) $\frac{10 \times 10}{2} = 50$ lb., Ans. $\sqrt{10^2 - 2^2} = 9.798$ ft., length of base; $\frac{9.798 \times 10}{2} = 48.99 = 49$ lb. nearly.
(2.) $\frac{8 \times 1000}{100} = 80$ lb.

198b. (1.) . . plane 15 ft. . . height $2\frac{1}{2}$ ft. . . 50 lb. ?
Ans. 300 lb.; $295\frac{1}{5}$ lb.
(2.) . . 45 ft. in 1000, . . 1500 lb. . . ? Ans. $67\frac{1}{2}$ lb.

200a. (1.) $8 \times 2 \times 3.1416 = 50.2656$ feet, the distance the power moves at one turn of the screw; therefore $\frac{4000 \times 1\frac{1}{2}}{50.2656 \times 12} = \frac{6000}{603.1872} = 9.948$ lb. $\frac{50.2656 \times 12 \times 15}{1\frac{1}{2}}$ $= 6031.872$ lb.

(2.) $\frac{8 \times 2 \times 12 \times 3.1416 \times 10}{8000} = .565388$ of an inch; $\frac{8000 \times .5}{10} = 400$ in., the distance the power moves in one turn of the screw; therefore, $\frac{400}{3.1416} =$ the diam. of the circle, and $\frac{400}{2 \times 3.1416 \times 12} =$ the length of the lever in ft. $= 5.3$ ft.
(3.) $\frac{8 \times 2 \times 12 \times 3.1416 \times 100}{1} = 45{,}239$ lb.
(4.) $\frac{45.239 \times 16}{4} = 169{,}646\frac{1}{4}$ lb.
(5.) $1 : 2^3 = 169646\frac{1}{4} : 1{,}357{,}170$ lb.

200b. (1.) . . lever 6 ft. . . $\frac{3}{4}$ in. . 10,000 lb. ?
Ans.* $16\frac{1}{2}\frac{5}{6}\frac{1}{4}$ lb.

(2.) . . lever 10 ft., . . 15 lb. . . 18,000 lb. ?
Ans. .628 in.

How long a lever if the worm is 1 in. broad ?
Ans. 15.91 ft.

(3.) . . $1\frac{1}{2}$ in. . . 150 lb. . . 8 ft. Ans. 60,343 lb.

(4.) . . 12 ft. long, . . 3 ft. high ? Ans. 241,372 lb.

(5.) . . 4 pulleys . . ? Ans. 3,861,952 lb.; 1,930,916 lb.

201a. (18.) The front side and two ends are $5\frac{1}{2} + 5$, or $10\frac{1}{2}$ ft. long, and $\frac{2}{3}$ ft. deep; $\frac{2}{3}$ of $\frac{21}{2} = \frac{14}{2} = 7$ sq. feet. The top is $\frac{21}{2} \times \frac{5}{2} = \frac{55}{4} = 13\frac{3}{4}$ sq. ft., which, added to 7, gives $20\frac{3}{4}$ sq. ft. This, at 50 cts. per sq. ft., will cost $\frac{1}{2}$ as many dollars as there are sq. ft.; at 25 cts., $\frac{1}{4}$ as many; at $33\frac{1}{3}$ cts., $\frac{1}{3}$ as many, &c.

(20.) The number of cubic yards will be $\frac{36 \times 20 \times 7\frac{1}{2}}{27}$ $= \frac{4 \times 20 \times 7\frac{1}{2}}{3}$. Say 4 times 20 are 80. $7\frac{1}{2}$ times 80 are 600, which, divided by 3, gives 200; $\frac{3}{4}$ of which gives \$150, the cost.

(21.) $\sqrt{12^2 + 16^2} = \sqrt{400} = 20$.

(22.) If it contained 1 acre, and one dimension were 40 rods, the other would be 4 rods; but as it contains $7\frac{1}{2}$ acres, the other dimension will be $7\frac{1}{2}$ times 4, or 30 rods. $\sqrt{40^2 + 30^2}$ $= \sqrt{2500} = 50$ the diagonal $(40 + 30) \times 2 \times 1\frac{1}{4} = \$175$.

(24.) The garden contains 8100 sq. ft.; the required lot contains $\frac{8100}{32400} = \frac{1}{4}$ as much; its dimensions must be $\frac{1}{2}$ as great. 32400 = 4 times 8100.

(25.) It will take $\frac{1}{8}$ as many if each dimension is twice as large, and $\frac{1}{125}$ as many if each dimension is $\frac{1}{5}$ as great.

(26.) $\frac{5}{2} \times \frac{5}{2} \times \frac{5}{3} = 12\frac{1}{2}$ cu. ft. The dimensions being 3 times as great, the solidity will be 27 times as great. 27 times $12\frac{1}{2}$ $= \frac{1}{8}$ of 2700 $= \frac{1}{8}$ of 2400 + 240 + 60 $= 337\frac{1}{2}$. The height of the part cut off will be $\frac{2}{3}$ of that of the whole pyramid; its solidity will, therefore, be $\frac{8}{27}$ of the whole.

* The circumference of a circle being $3\frac{1}{7}$ times its diameter. By using the ratio 3.1416, the result will be somewhat different.

(27.) A can do the work twice in one day, B 3 times, and C 5 times; they can all do it 10 times in 1 day; they will therefore do it once in $\frac{1}{10}$ of 1 day.

(28.) A, B, and C can do $\frac{1}{8}$ of it in 1 day. B can do $\frac{1}{8}$, and C $\frac{1}{10}$ of it. Subtracting what B and C can do in a day from what they all can do in a day, will give what A can do in 1 day. $\frac{1}{8} - (\frac{1}{8} + \frac{1}{10}) = \frac{4}{120} - (\frac{15}{120} + \frac{12}{120}) = \frac{4}{120} - \frac{27}{120} = \frac{1}{120}$. A can do in 1 day; — it will take him as many days as there are times 13 in 120; $9\frac{3}{13}$ days, Ans.

(29.) $\frac{3}{8} + \frac{1}{4} = \frac{5}{8}$; $\frac{1}{3}$ of the remainder is $\frac{1}{8}$. He has spent $\frac{3}{4}$ of his money; \$100 must, therefore, be $\frac{1}{4}$ of what he had.

Ans. \$400.

(30.) $200 \times 4 = 800$; $300 \times 6 = 1800$; $500 \times 2\frac{4}{5} = 1400$. Their shares of the gain are therefore as the numbers 4, 9, and 7. A must have $\frac{4}{20} = \frac{1}{5}$; B $\frac{9}{20}$, and C $\frac{7}{20}$ of \$362. $\frac{1}{5}$ of $350 + 12 = \$72\frac{2}{5}$ A's.; $\frac{1}{20}$ of $360 + 2 = \$18\frac{1}{10}$, and $\frac{9}{20}$ of it will be 9 times $\$18\frac{1}{10} = \$162\frac{9}{10}$ B's share; and $\frac{7}{20}$ will be 7 times $18\frac{1}{10} = \$126\frac{7}{10}$, C's share.

(31.) $500 \times 9 = 4500$; $700 \times 5 = 3500$. The sum of A's and B's products of stock and time is 8000; and as $\frac{1}{8}$ of the gain belongs to C, and $\frac{8}{8}$ to A and B, C's product of stock and time must have been 4000; his time being 10 months, his stock must have been valued at $4000 \div 10 = \$400$. If 500 bushels are worth \$400. one bushel is worth 80 cents, the Answer.

(32.) Their ages are as the numbers 5 and 6; therefore A's age is $\frac{5}{11}$, and B's $\frac{6}{11}$ of the sum of both; $\frac{5}{11}$ of $55 = 25$, A's age; $\frac{6}{11}$ of $55 = 30$, B's age.

(33.) Their ages are as the numbers 3 and 4. Three times John's and 4 times William's are as the number 9 and 16. Three times John's age is, therefore, $\frac{9}{25}$ of 100 years, and 4 times William's is $\frac{16}{25}$ of 100 years. Ans. John's age $\frac{9}{25}$ of $100 = 12$, and William's $\frac{16}{25}$ of 100 years $= 16$ years.

(34.) The length of the arms of the lever must be as the numbers 10 and 15, i. e., as 2 to 3. The 10 lb. weight must be $\frac{2}{5}$ of 15 feet, and the 15 lb. weight $\frac{3}{5}$ of 15 feet, from the fulcrum.

(35.) The bar, which sustains $\frac{2}{3}$ of the weight, must be $\frac{1}{2}$ as far from the centre as the man who is to carry $\frac{1}{3}$; $\frac{1}{2}$ of $12\frac{1}{2} = 6\frac{1}{4}$.

(36.) The hogshead may be regarded as a movable pulley, in

which a given power will balance twice its weight; or the diameter of the hogshead may be regarded as a lever of the second kind, the fulcrum being on the plane, the weight attached to the centre, and the power to the other end; here, also, the power is twice as far from the fulcrum as the weight is. Therefore, the length of the plane being 3 times its height, the plane will support $\frac{2}{3}$ of the 1200 lbs., and the rope $\frac{1}{3}$, or 400 lbs.; and as 1 lb. at the end of the rope will balance 2 lbs. at the centre of the hogshead, a power of 200 lbs. will balance the whole.

202a. (11.) $207\frac{5}{16} + 15\frac{3}{16} = 222\frac{7}{24}$; $207\frac{5}{16} - 15\frac{3}{16} = 191\frac{11}{12}$; $\frac{2241}{48} \times \frac{243}{16} = \frac{205221}{256} = 3145\frac{101}{256}$.

(13.) $\frac{788}{9} \times \frac{48}{3127} = \frac{12608}{93681} = 1\frac{3227}{93681}$; $\frac{8443}{6} \times \frac{10}{3} \times \frac{6}{4} \times \frac{9}{406} = 71\frac{325}{812}$.

(14.)

12) 34180476
3) 2848373
$5\frac{1}{2}$) 949457 .. 2 ft.
11) 1898914
40) 172628 .. 3 yd.
8) 4315 .. 28 rd.
539 M. 3 fur.

9) 4418679
$30\frac{1}{4}$) 490964 .. 3 sq. ft
121) 1963856
40) 16230 .. $6\frac{1}{2}$ sq. yd.
4) 405 .. 30 rd.
101 A. 1 R.

1728) 156485160
27) 90558 .. 936 cu. in.
3354 cu. yd.

(15.)

£			
	1	2	$4\frac{1}{2}$
		10	
	11	3	9
		9	
	100	13	9
		5	
£	503	8	9.
		10	

16.)

£			
	3	4	$8\frac{1}{4}$
		8	
	25	17	6
		9	
	232	17	6
	6	9	$4\frac{1}{2}$
£	239	6	$10\frac{1}{2}$.

(17.)

A.	R.	sq. rd.	sq. yd.	sq. ft.	sq. in.	
3	3	27	18	7	58	
					3	
11	3	2	$25\frac{3}{4}$	4	30	
				6	108	$= \frac{3}{4}$ yd.
11	3	2	26	1	138	prod. by 3.
					4	
47	0	11	$13\frac{1}{4}$	7	120	
				2	36	$= \frac{1}{4}$ yd.
47	0	11	14	1	12	prod. by 12.
70	2	17	$5\frac{3}{4}$	2	108	
				6	108	$= \frac{3}{4}$ yd.
70	2	17	6	0	72	prod. by $6 \times 3 = 18$.
188	1	5	$25\frac{3}{4}$	4	48	
				6	108	$= \frac{3}{4}$ yd.
188	1	5	26	2	12	prod. by $3 \times 4 \times 4 = 48$.

(18.)

	A.	R.	sq. rd.	sq. yd.	sq. ft.	sq. in.	
5)	5	2	15	19	1	100	
2)	1	0	19	3	7	$77\frac{3}{5}$	by 5.
	2	9	17	0		$56\frac{4}{5}$	by $2 \times 5 = 10$.
	1	19	21	4		$1\frac{13}{15}$	by $5 \times 3 = 15$.
		35	24	8		$101\frac{23}{25}$	by $5 \times 5 = 25$.

(19.) $24 = 2^3 \times 3$; $32 = 2^5$; $36 = 2^2 \times 3^2$; $48 = 2^4 \times 3$; $60 = 2^2 \times 3 \times 5$. $2^5 \times 3^2 \times 5 = 1440$, the least com. mult. $25 = 5^2$; $35 = 5 \times 7$; $45 = 5 \times 3^2$; $75 = 5^2 \times 3$. $5^2 \times 7 \times 3^2 = 1575$, the Ans.

(20.) $144 = 2^4 \times 3^2$; $256 = 2^8$; $872 = 2^3 \times 109$; $996 = 2^2 \times 3 \times 83$; 2^2 the only divisor common to them all; 4 is therefore the greatest com. measure.

(21.) $\frac{25 \times 16 \times 12 \times 32 \times 15 \times 48}{5 \times 40 \times 8 \times 24 \times 144} = 20$.

(22.)

$3\frac{5}{9}$	=	$3\frac{30}{54}$
$4\frac{8}{9}$	=	$4\frac{48}{54}$
$3\frac{5}{18}$	=	$3\frac{15}{54}$
$15\frac{16}{27}$	=	$15\frac{32}{54}$
$104\frac{13}{54}$	=	$104\frac{13}{54}$
$131\frac{1}{9}$		$129\frac{98}{54}$.

(23.) $27\frac{3}{7} = 27\frac{21}{49}$ $180\frac{18}{99} = 180\frac{2}{11}$
$5\frac{8}{17} = 5\frac{7}{51}$ $137\frac{1}{25} = 137\frac{4}{100}$
Ans. $21\frac{14}{51}$. Ans. $42\frac{19}{275}$.

(24.)

£ $\frac{3}{7}$	= 8s.	6d.	$3\frac{3}{7}$ qr.	=	$\frac{429}{1400}$
.32 s.	= 0	3	3.36	=	$\frac{336}{1400}$
$\frac{4}{5}$ d.	= 0	0	$1\frac{7}{25}$	=	$\frac{1232}{1400}$
$\frac{1}{4}$ qr.	= 0	0	$0\frac{1}{4}$	=	$\frac{175}{1400}$
Ans.	8s.	11 d.	$0\frac{1143}{1400}$ qr.		$1\frac{143}{1400} = 1\frac{143}{350}$.

(25.)

		fur.	rd.	yd.	ft.	in.
$\frac{3}{14}$ m	=	1	28	3	0	$5\frac{1}{7}$
$\frac{4}{5}$ fur.	=	0	17	4	0	10
$\frac{5}{12}$ rd.	=	0	0	2	0	$10\frac{1}{2}$
$\frac{8}{15}$ yd.	=	0	0	0	1	$7\frac{1}{5}$
$\frac{3}{4}$ ft.	=	0	0	0	0	9
$\frac{4}{5}$ in.	=	0	0	0	0	$0\frac{4}{5}$
		2	6	$4\frac{1}{2}$	1	$6\frac{3}{14}$
					1	6 = $\frac{1}{2}$ yd.
		2	6	5	0	$0\frac{3}{14}$.

(27.) $77\frac{3}{14} = 77\frac{33}{154}$
$51\frac{3}{8} = 51\frac{57}{154}$
$25\frac{24}{154}$ less.
$129\frac{3}{154}$ larger.

(28.) Having paid 15 per ct., 85 per ct. remains to be paid, 17 per ct. of which is 14.45 per ct., which, subtracted from 85 per ct., leaves 70.55 per ct. 20 per ct. of this is 14.11 per ct. He has paid 15 + 14.45 + 14.11 per ct. = 43.56 per ct., leaving 56.44 per ct. unpaid. 56.44 per ct. of \$10,000 = \$5644. Or 15 per ct. of \$10,000 = \$1500, the first payment; 17 per ct. of \$8500 = \$1445, the second payment; 20 per ct. of this remainder, viz., 7055, &c.

(29.) The interest of \$1 for 2 years 6 months, 25 days, at 6 per ct., is \$.154$\frac{1}{6}$; of \$145.75, it is \$22.47, to which adding $\frac{1}{12}$ of itself, or \$1.87, gives \$24.34, the interest at 6$\frac{1}{2}$ per ct.

(30.) The interest of \$1 for 2 years 3 months 2 days, at 6 per ct., is \$.135$\frac{1}{3}$; of \$751.16 it is \$101.66, from which subtracting $\frac{1}{24}$ of itself, or \$4.24, gives \$97.42, the interest at 5$\frac{1}{2}$ per ct. \$97.42 + \$751.16 = \$848.58, the amount.

(31.) BY THE LEGAL RULE.

Principal,				$500.00
Int. for 5 mo. 7 da. = $.026⅙ × 500 =				13.08
Amount to Jan. 1, 1847,				513.08
First payment,				100.00
New principal,				413.08
Int. for 3 mo. 14 da. = $.017½ × 413.08,				7.16
Amount to April 15, 1847,				420.24
Second payment,				75
New principal,				345.24
Int. for 7 mo. 2 da. = $.035½ × 345.24 =	$12.20			
Third payment,	10.00			
	2.20			
Int. for 1 mo. 29 da. = $.009⅔ × 345.24 =	3.39			5.59
Amount due Jan. 15, 1848,				350.83
Fourth payment,				150.00
New principal,				200.83
Int. for 7 mo. 17 da. = $.037⅚ × 200.83 =				7.60
Amount due Sept. 1, 1848,				208.43
Fifth payment,				185.85
New principal,				22.58
Int. for 4 mo. = $.02 × 22.58 =				.45
Amount due Jan. 1, 1849,				$23.03

(31.) BY THE COMMON METHOD.

Am'nt of principal $500 for 2 yrs. 5 mos. 7 days,	= $.146⅙ × 500 + 500	= $573.08	
Am'nt of 1st payt. $100 for 2 yrs.	= $.12 × 100 + 100	= $112.00	
Am'nt of 2d payt. $75 for 1 yr. 8 mo. 17 da.	= $.102⅚ × 75 + 75	= 82.71	
Am'nt of 3d payt. $10 for 1 yr. 1 mo. 15 da.	= $.067½ × 10 + 10	= 10.68	
Am'nt of 4th payt. $150 for 0 yr. 11 mo. 17 da.	= $.057⅚ × 150 + 150	= 158.68	
Am'nt of 5th payt. $185.75 for 0 yr. 4 mo. 0 da.	= $.02 × 185.85 + 185.85	= 189.57	553.64
Subtracting the amount of payments from amount of principal gives the balance due,			$19.44

(31.) BY COMPOUND INTEREST.

Am'nt of principal, $500 for 2 yrs. 7 mo. 5 da.	= $1.15496 × 500	=	577.48
Am'nt. of 1st payt. $100 for 2 yrs. 0 mo. 0 days,	= $1.1255 × 100	= $112.55	
Am'nt of 2d payt. $75 for 1 yr. 8 mo. 17 days,	= $1.1067 × 75	= 83.01	
Am'nt of 3d payt. $10 for 1 yr. 1 mo. 15 days,	= $1.0688 × 10	= 10.69	
Am'nt of 4th payt. $150 for 0 yr. 11 mo. 17 da.	= $1.05866 × 150	= 158.80	
Am'nt of 5th payt. $185.85 for 4 mo. 0 days,	= $1.02 × 185.85	= 189.57	
			554.62
Subtracting the amount of the payments from that of the principal gives,			$22.86 bal.

(32.) $(25 + 30) \times 2 \times 10 = 900$ sq. ft. in the four walls. $25 \times 20 \times 2 = 1000$ sq. ft. in the floors and ceiling. $900 + 1000 = 1900$ sq. ft., Ans.

(33.) $20^2 + 25^2 =$ the square of the length of a diagonal on the floor, or $20^2 + 25^2 + 10^2 =$ the square of the answer, and $\sqrt{20 + 25^2 + 10^2} = 33.54$ ft., Ans.

(34.) The globe would be 10 feet in diameter. $10 \times 3.1416 \times 10 = 314.16$ sq. ft.; $10^3 \times .5236 = 523.6$ cu. ft.

(35.) $\frac{\overset{33}{\$25\emptyset} \times 450}{\overset{7}{11\emptyset}} = 2121\frac{3}{7}$ sec. $= 35$ min. $21\frac{3}{7}$ sec.

(36.) $\frac{2\emptyset1}{2} \times \frac{2\emptyset1}{2} = \frac{1\,5\emptyset\emptyset\,5\,1}{8} = 9493\frac{7}{8}$ sq. ft., the area of the whole garden. $15^2 \times .7854 = 176.715$ sq. ft., the area of the pond. $9493.875 - 176.715 = 9317.16$, the area exclusive of the pond.

(37.) $15 + 1$ ft. the mean of the inside and outside diameters of the wall. $16 \times 3.1416 \times 4 = 50.2656 \times 4 = 201.0624$ cu. ft. in the wall; and $15 \times 3.1416 \times 4 = 47.124 \times 4 = 188.496$ sq. ft. of surface.

(38.) $(15 + 3\frac{1}{2}) \times 3.1416 \times 3\frac{1}{2} = 58.1196 \times 3\frac{1}{2} = 203.4186$ sq. ft., area of the walk.

(39.) $\sqrt{(\frac{281}{2})^2 + (\frac{261}{4})^2} \div 2 = \sqrt{\frac{84681}{4} + \frac{68121}{16}} \div 2 = \sqrt{\frac{338724}{16} + \frac{68121}{16}} \div 2 = \frac{837.844}{4} \div 2 = 79.7305$ feet, the Answer.

(40.) If the dimensions of the garden are to be the *inside* dimensions of the wall, $(145\frac{1}{2} + 65\frac{1}{4}) \times 2 + 4 = 425\frac{1}{2}$ will be the length of the wall, and $425\frac{1}{2} \times 6 \times 1 = 2553$ cu. ft. in the walls, and $2553 \times 27 = 68{,}931$, the number of bricks. If the dimensions of the garden are the *outside* dimensions of the wall, $(145\frac{1}{2} + 65\frac{1}{4}) \times 2 - 4 = 417\frac{1}{2}$ ft., will be the length of the wall, and $417\frac{1}{2} \times 6 \times 27 = 67{,}635$ the number of bricks.

(41.) As the sand-stone projects equally on each side of the wall, its length will be the same as the length of the wall, the width $1\frac{1}{2}$ ft., and the thickness $\frac{1}{2}$ ft.; therefore, $417\frac{1}{2} \times \frac{4}{3} \times \frac{1}{2} = 417\frac{1}{2} \times \frac{2}{3} = 278\frac{1}{3}$ cu. ft., or $425\frac{1}{2} \times \frac{4}{3} \times \frac{1}{2} = 283\frac{2}{3}$ cu. ft.

(42.) $\frac{5280 \times \overset{40}{\cancel{240}} \times \overset{12}{\cancel{36}} \times 6}{27} = 15{,}206{,}400$ cu. yd., which, at $16\frac{2}{3}$ cts. per yd., is $\frac{15206400}{6} = \$2{,}534{,}400$. *Note.*—The average width is $\frac{40+32}{2} = 36$ ft.

(43.) $\frac{62\frac{1}{2} \times 2 + 56\frac{1}{4}}{3} = 60\frac{5}{12}$ cts., the average cost per gross. $\$.60\frac{5}{12} \times 150 = \$90.62\frac{1}{2}$, cost. $\$.66\frac{2}{3} \times (150 - 2) = \$\frac{2}{3} \times 148 = \$98\frac{2}{3} = \$98.67$ sold for; his gain was \$8.04; the gain per ct. was $\frac{804000}{9006275} = 8.883$ per ct.

(44.) $\frac{8}{5} - \frac{3}{10} = \frac{9}{10}$, and $\frac{9}{10} + \frac{3}{10} = \frac{12}{10}$; i. e., he has $\frac{12}{10} = \frac{6}{5}$ of what he had at first. \$12,060 is $\frac{6}{5}$ of \$10,050.

(45.) He realized at the first sale $87\frac{1}{2}$ per ct. of the cost of the goods. 120 per ct. of which is 105 per ct. His gain was therefore 5 per ct. on the money first invested.

(46.) A can mow $\frac{4}{21}$ of it in an hour; B $\frac{3}{17}$, and C $\frac{4}{31}$; they can all do $\frac{2108}{21607} + \frac{2548}{21607} + \frac{2782}{21607} = \frac{7438}{21607}$ of it in 1 hour. It will take them as many hours as there are times 7438 in 21607, which is $2\frac{6}{7}\frac{3}{4}\frac{1}{3}\frac{1}{8}$ hours, the Answer.

(47.) He realized 90 per ct. of the cost, whereas he expected to realize 115 per ct. \$4.50 is, therefore, $\frac{90}{115} = \frac{18}{23}$ of what he expected to sell it for. \$5.40 is $\frac{18}{23}$ of $\frac{23}{18}$ of \$5.40 = \$6.90.

(48.) The length of the sides and ends of the box, exclusive of the cover and the bottom, is $(5\frac{3}{8} + 4\frac{5}{12}) \times 2 - \frac{3}{8} = 20\frac{1}{8} -$

$\frac{3}{4} = 19\frac{1}{2}$; the height being $3\frac{1}{6}$ feet, (deducting 4 inches for the thickness of the top and bottom.) $19\frac{1}{2} \times 3\frac{1}{6} = \frac{39}{2} \times \frac{19}{6} = \frac{741}{12} = 61\frac{3}{4}$ sq. ft. of plank; the area of the top and bottom is $5\frac{2}{3} \times 4\frac{5}{12} \times 2 = \frac{17}{3} \times \frac{53}{12} \times 2 = \frac{901}{18} = 50\frac{1}{18}$ square feet, making in all $111\frac{2}{36}$ sq. ft. of plank. Reducing this to board measure, by multiplying by 2, we have the answer $223\frac{1}{18}$ feet, which, at $25 per thousand feet, will come to $5.59. Or the dimensions may be taken in inches, and the product divided by $\frac{144}{2} = 72$, to get the number of feet, board measure. The capacity of the box is $5\frac{1}{3} \times 4\frac{1}{12} \times 3\frac{1}{6} = \frac{16}{3} \times \frac{49}{12} \times \frac{19}{6} = \frac{18662}{216} = 68\frac{86}{216}$ cu. ft.

(49.) The slant height is $\sqrt{40^2 + 6^2} = \sqrt{1636} = 40.4475$ feet. The circumference is $3.1416 \times 12 = 37.6992$ ft. The area is $\frac{40.4475 \times 37.7}{2} = 762.426$ sq. ft. $= 84.714$ sq. yd., which, at 20 cts. per yd., comes to $16.94.

(50.) If it turns 15° in 1 hour, it will turn 1° in $\frac{1}{15}$ of an hour, or 4 minutes; and if it turns 1° in 4 minutes, it will turn $\frac{1}{4}$ of a deg. in 1 minute.

(51.) 15° = 1 h.; 1° = 4 min. of time; 15′ of a deg. = 1 min. of time; 1′ of a deg. = 4 sec. of time. Hence, to find the difference in time between London and Salem, say 60° = 4 h., 10° = 40 min., 45′ of a deg. = 3 min. of time, and 9″ of a deg. = 36 sec. of time. The difference is 4 h. 43 min. 36 sec., and as London is to the eastward of Salem, the time there is 4 h. 43 min. 36 sec. P. M.

(52.) 60° = 4 h., 11° = 44 min., 4′ = 16 sec.; the difference is 4 h. 44 min. 16 sec., which, being added to 9 h. A. M., gives 1 h. 44 min. 16 sec., P. M., at London.

90° — 71° 4′ = 18°56′, the difference in longitude between Boston and New Orleans. 15° = 1 h., 3° = 12 min., 45′ = 3 min., 11′ = 44 sec., the difference in time; and New Orleans being to the westward, the time will be 9 h. — 1° 15′ 44″ = 7 h. 44 min. 16 sec., A. M.

122° 14′ — 71° 04′ = 51° 10′, the difference in longitude between Boston and San Francisco. 45 = 3 h., 6° = 24 min., 10′ = 40 sec. The difference in time is 3 h. 24 min. 40 sec. 9h. — 3 h. 24 min. 40 sec. = 5 h. 35 min. 20 sec., A. M., the time at San Francisco. 71° 4′ + 28° 59′ = 100° 3′ difference in longitude between Boston and Constantinople. 90° = 6 h., 10° = 40 min., 3′ = 12 sec. The difference

in time is 6 h. 40 min. 12 sec., which, being added to 9 h., gives 3 h. 40 min. 12 sec., P. M., at Constantinople.

(53.) Since 1 hour's difference in time makes 15° difference in longitude, 20 minutes will make $\frac{1}{3}$ of 15° = 5° difference of longitude. Hence, he came from a meridian 5° to the westward.

(54.) The difference of longitude is $3\frac{1}{4} \times 15° = 48° 45'$. His longitude is, therefore, 48° 45', W.

(56.) Similar surfaces are to each other as the squares, and similar solids as the cubes, of their like dimensions. Hence, $11.25^2 = (\frac{45}{4})^2 = \frac{2025}{16}$ is the ratio of their surfaces, and $(\frac{45}{4})^3 = \frac{91125}{64}$, the ratio of their solid contents; that is, the surface of Jupiter is $126\frac{9}{16}$ times that of the earth, and his solid contents $1423\frac{53}{64}$ times the earth's.

(57.) The solid contents of similar figures being as the cubes of their like dimensions, a ball whose diameter is $\frac{1}{2}$ as great will weigh $(\frac{1}{2})^3 = \frac{1}{8}$ as much; and a ball whose diameter is 4 times as great will weigh $4^3 = 64$ times as much; and since the like dimensions of similar solids are as the cube roots of their solid contents, the diameter of a ball that weighs 3.375 as much must be $\sqrt[3]{3.375} = 1.5$ times as great. $8 \times 1.5 = 12$ inches, the Answer.

(58.) The length of the ditch is $(50 + 25) \times 2 + (4 \times 3) = 162$ feet; $162 \times 3 = 486$ sq. ft. will be its surface. The quantity of earth to be thrown up is $50 \times 25 \times \frac{3}{4} = 937\frac{1}{2}$ cu. ft.; dividing this, which is the solid contents of the ditch, by its surface, gives 1.929 feet, the depth of the ditch.

(59.) $15.5 \times 12.8 = 198.4$ sq. ft., the surface of the floor, and $3 \times 3.75 = 11.25$ sq. ft., the surface, which will be covered by 1 yard of carpeting; therefore, $\frac{15.5 \times 12.8}{3 \times 3.75} = \frac{1984}{1125}$

$17\frac{659}{1125}$ yards, the Answer.

(60.) $(35 + 22) \times 2 - (1\frac{1}{3} \times 4) = 108\frac{2}{3}$ ft., the length of the walls; and $108\frac{2}{3} \times 20 = 2173\frac{1}{3}$ sq. ft., the surface of the walls. $3\frac{1}{2} \times 8 \times 3 = 92$ sq. ft. in the doors; $2\frac{1}{2} \times 6\frac{1}{4} \times 17 = 301\frac{1}{4}$ sq. ft. in the windows; deducting this, viz., $92 + 301\frac{1}{4}$ from $2173\frac{1}{3}$, leaves $1780\frac{7}{12}$ sq. ft., the surface of the walls, exclusive of the doors and windows; and $1780\frac{7}{12} \times 1\frac{1}{3} = 2373\frac{1}{16}$ cu. ft. of masonry in the walls.

$22 \times 6 \times 2 = 264$ ft., the surface of the gable ends; from this deduct for the two windows $2\frac{1}{2} \times 5\frac{1}{3} = 26\frac{2}{3}$ sq. ft., gives

$237\frac{1}{3}$ sq. ft. for the surface of the gable ends, exclusive of the windows, or $237\frac{1}{3}$ cu. ft. of masonry in the gable ends. $(2373\frac{1}{18} + 237\frac{1}{3}) \times 27 = 2611\frac{1}{18} \times 27 = 70{,}498\frac{1}{2}$ bricks.

(61.) Using the formula, page 208, $\frac{(1 \times 1.06^{40}) - 1}{1.06 - 1} \times 150$ $= 36.78559 \times 150 =$ \$5517.84. Or, from table III., page 262, take the amount of an annuity of \$1 for 20 years, and multiply this amount by 150; thus, $36.78559 \times 150 =$ \$5,517.84, the Answer.

(62.) $\frac{(1 \times 1.06^{29}) - 1}{1.06 - 1} =$ \$73.639798, the amount of an annuity of \$1 for 29 years. He must therefore save as many dollars annually as there are times \$73.64 in \$10,000. $\frac{10{,}000}{73.64}$ = \$135.80.

(63.) 5000 gallons = 1155000 cubic inches. Let $d =$ the diameter, h the height, and c the capacity, $c = d^2 \times .7854 \times h$, and therefore, (98) $d^2 = \frac{c}{.7854 \times h}$, and $d = \sqrt{\frac{c}{.7854}} \times h$. Hence, $\sqrt{\frac{1155000}{.7854 \times 120}} = \sqrt{12254.9} = 110.7$ in. = 9 ft., 2.7 in., the Answer.

Or, since, to find the capacity, we square the diameter, and multiply that by .7854, and then that product by the height, so, in this question, by reversing the process, we may divide the capacity by the height, and that quotient by .7854, and take the square root of that quotient for the diameter.

(64.) Average *due* August 1, 1849.

1849.		days.			
Jan. 15,	\$500 00				Jan. 16.
Feb. 3,	350 00	19	6,650		Feb. 28.
Apr. 13,	290 00	88	25,552		Mar. 31.
June 17,	140 00	153	21,420		Apr. 30.
July 21,	960 00	187	179,520		May 31.
Aug. 9,	620 00	206	127,720		June 30.
Oct. 18,	430 00	276	118,680		July 31.
Nov. 1,	870 00	290	252,300		Aug. 1st, 1849.
Dec. 11,	710 00	330	234,300		198.
	4870 00	)	966.110	(198 days *from* Jan'y. 15, 1849.	

(65.) $(18\frac{1}{2})^2 \times .7854 \times 8 = 2150.8$ cu. in. in a bushel, and $\sqrt[3]{2150.8} = 12.9074$ in the side of a cube to contain a bushel.

(66.) A and B can do $\frac{1}{3}$ of it in 1 day; B and C $\frac{1}{4}$, and A and C $\frac{1}{5}$ of it in 1 day; $\frac{1}{3} + \frac{1}{4} + \frac{1}{5} = \frac{47}{60}$. This is what they can do, counting the work each does in one day twice; therefore, it is what all can do in 12 days.

(67.) B travels 3 miles a day more than A. In order to gain 60 miles, he must travel as many days as there are times 3 in 60, or 20 days; and he will travel $20 \times 15 = 300$ miles.

(68.) B must travel 100 miles more than A, before he can overtake A, and C must travel 100 miles further than B, before he will overtake B. Since B travels 3 miles per day more than A, it will take him $\frac{100}{3} = 33\frac{1}{3}$ days to overtake him. It will also take C $33\frac{1}{3}$ days to overtake B. They will therefore be together in $33\frac{1}{3}$ days. Or it may be solved thus: the number of times they will have to surround the island will be as the numbers 12, 15, and 18, or 4, 5, and 6, &c.

If C travelled 20 instead of 18 miles per day, the times they must travel round the island will be as the numbers 12, 15, and 20, because the numbers 12, 15, and 20, are prime to each other; that is, A must travel round it 12 times, B 15 times, and C 20 times, before they will all come together. Again, if A travels 12, B 18, and C 21 miles per day, the number of times they will have to travel round the island will be as the numbers 12, 18, and 21, or 4, 6, and 7.

(69.) After taking from the whole \$120 for A, and \$170 for C, the rest may be divided into 3 equal portions, $\frac{1000-290}{3} = 236\frac{2}{3}$ B's share. $\$236\frac{2}{3} + \$120 = \$456\frac{2}{3}$, A's share, and $\$456\frac{2}{3} + \$50 = \$506\frac{2}{3}$, C's share.

(70.) B is to have \$75 more than A, and C \$65 more than B, or \$140 more than A. Therefore, after taking out \$75 for B, and \$140 for C, the remainder may be divided equally. Thus, $\frac{\$1000-\$215}{3} = \$261\frac{2}{3}$, A's share; $\$261\frac{2}{3} + \$75 = \$336\frac{2}{3}$, B's share; and $\$336\frac{2}{3} + \$65 = \$401\frac{2}{3}$, C's share.

(71.) $\frac{\overset{110}{\cancel{5280}} \times 240{,}000}{\underset{3}{\cancel{1200}} \times \underset{3}{\cancel{60}} \times \underset{3}{\cancel{60}} \times \cancel{24}} = \frac{110}{9} = 12\frac{2}{3}$ da. $= 12$ da. 5 h. 20 minutes.

$\frac{\overset{55}{\cancel{5280}} \times \overset{2375}{\cancel{95{,}000{,}000}}}{\underset{3}{\cancel{1200}} \times \underset{3}{\cancel{60}} \times \underset{3}{\cancel{60}} \times \underset{3}{\cancel{24}}} = 4837\frac{2}{27}$ da. $= 13$ yrs. 89 da. 6 hours, 40 minutes.

$\frac{\overset{110}{\cancel{5280}} \times 3{,}700{,}000{,}000}{\underset{3}{\cancel{1200}} \times \underset{3}{\cancel{60}} \times \underset{3}{\cancel{60}} \times 24} = \frac{407000000}{9 \times 24} = 188425$ da. 22 h. 13 min. 20 sec. $=$ Ans.

